United States Patent [19]

Davin et al.

[11] **3,776,326**

[45] **Dec. 4, 1973**

[54] **PAVING MACHINE**

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[73] Assignee: **Blaw Knox Construction Equipment, Inc.,** Mattoon, Ill.

[22] Filed: **June 28, 1972**

[21] Appl. No.: **267,229**

Related U.S. Application Data

[62] Division of Ser. No. 889,542, Dec. 31, 1969, Pat. No. 3,700,288.

[52] **U.S. Cl.** ..... **180/9.2 R,** 280/106 R, 305/23, 305/27

[51] **Int. Cl.** **B62d 55/00**

[58] **Field of Search** ..... 305/23, 27, 25; 180/92 R; 280/106

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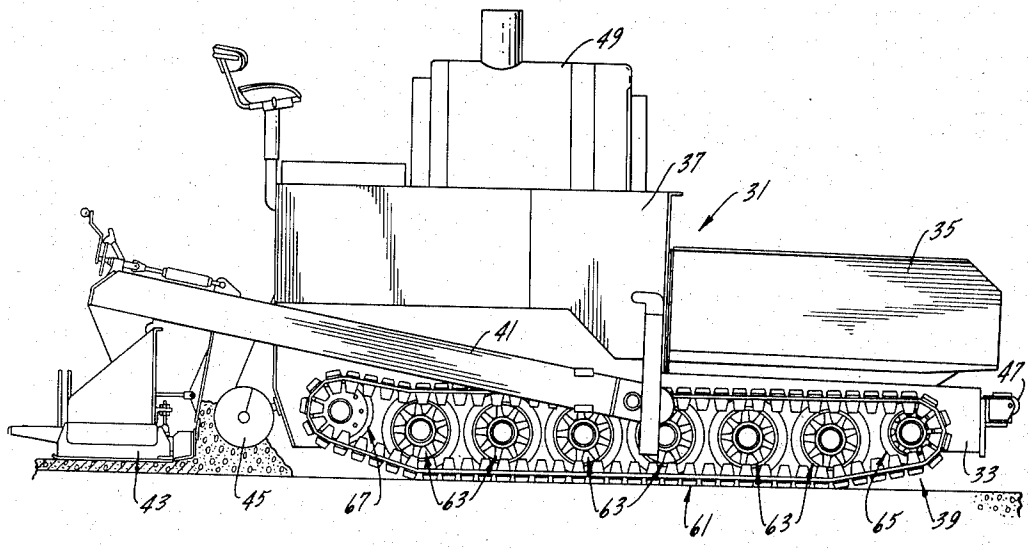
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Primary Examiner—Richard J. Johnson
Attorney—Mandeville & Schweitzer

[57] **ABSTRACT**

An asphalt paving machine mounted on rubber tread tracks. Each track is equally tensioned hydraulically. Each track is made of shoes which are individually connected to band sections. Replaceable rubber inserts are fastened to each shoe. Replaceable retainers connected to each shoe engage bogie wheels which are attached to bogie carriages pivotally mounted on a torsionally flexible machine frame. A drive sprocket for each track is directly driven by a separate hydrostatic transmission with the sprocket supporting the track shoes and bands to maintain a constant pitch diameter for the track. The gear train between the hydrostatic motor and the sprocket is completely enclosed. A manual automatic engine speed control system is provided which automatically brings the paving machine engine to idle speed when the paving machine is stopped and brings the engine to its governed speed whenever the paving machine is moved. A closed center hydraulic system supplies fluid to operate power actuators.

4 Claims, 17 Drawing Figures



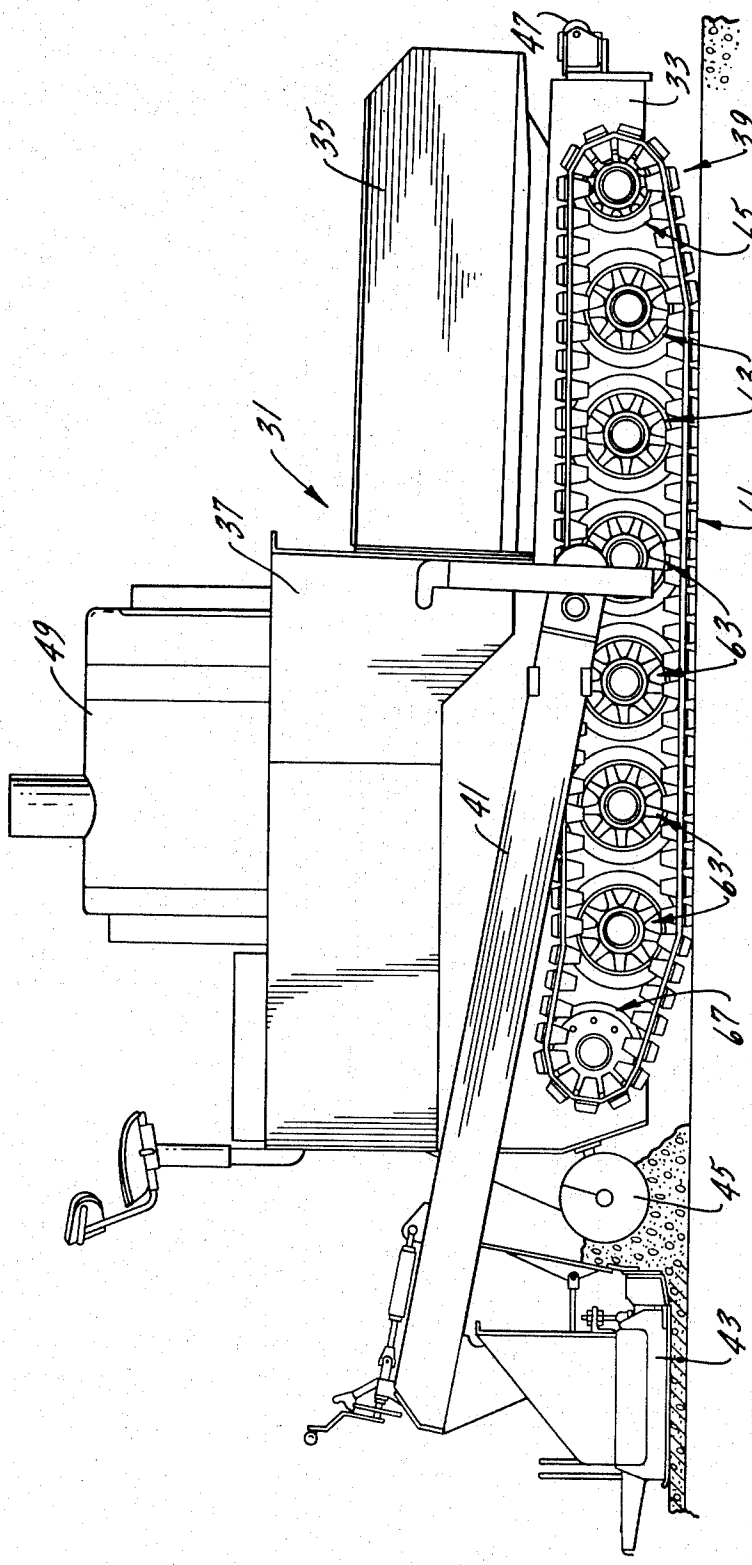


FIG. 1.

FIG. 2.

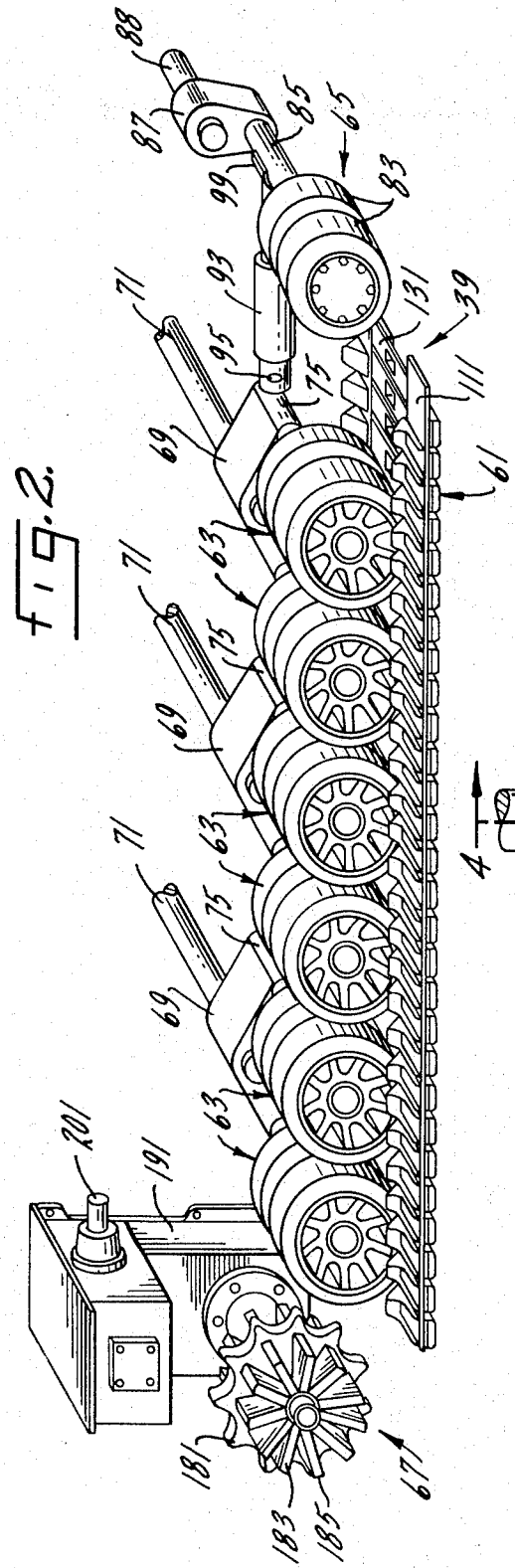
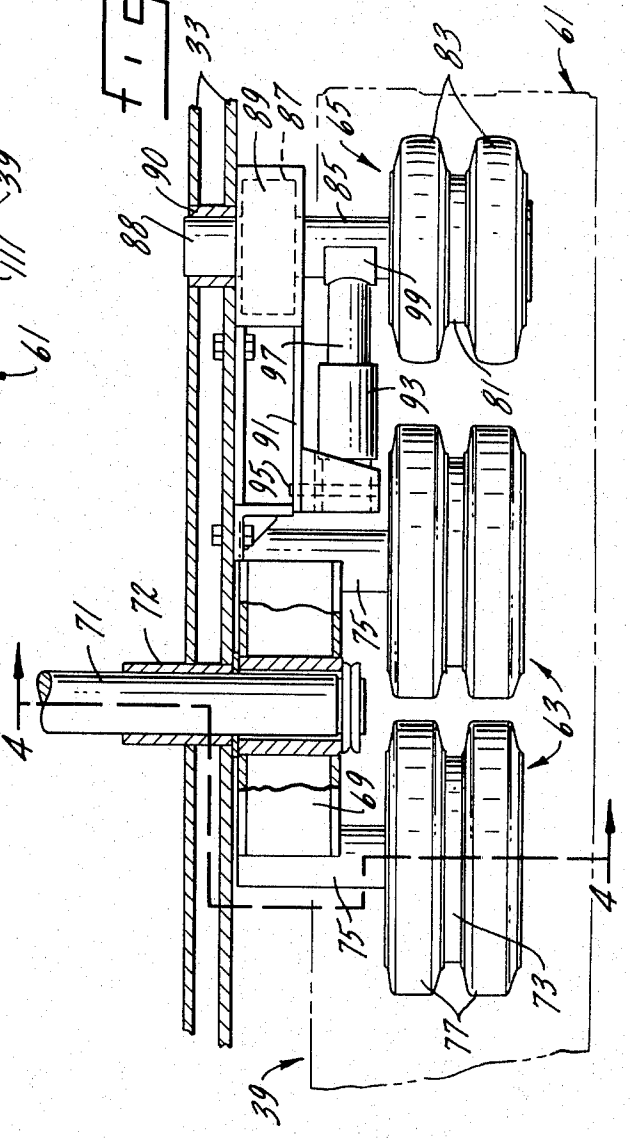

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FIG. 3.


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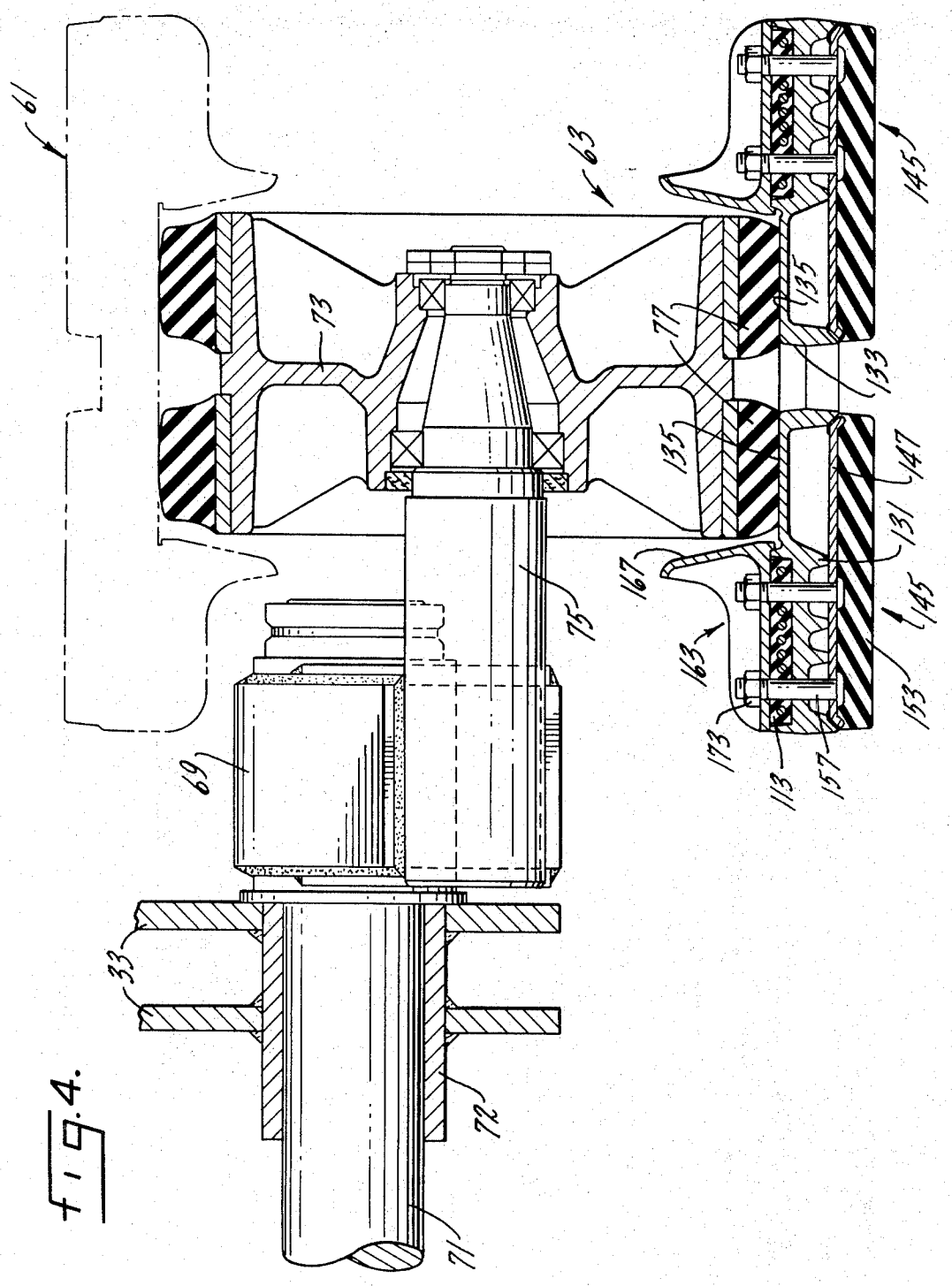

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FIG. 4.

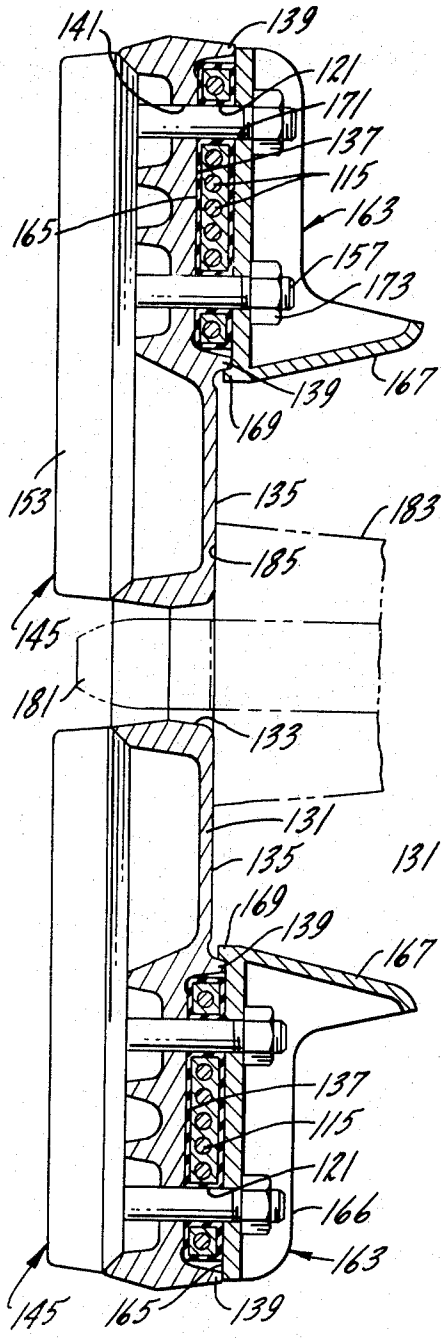

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Fig. 6.

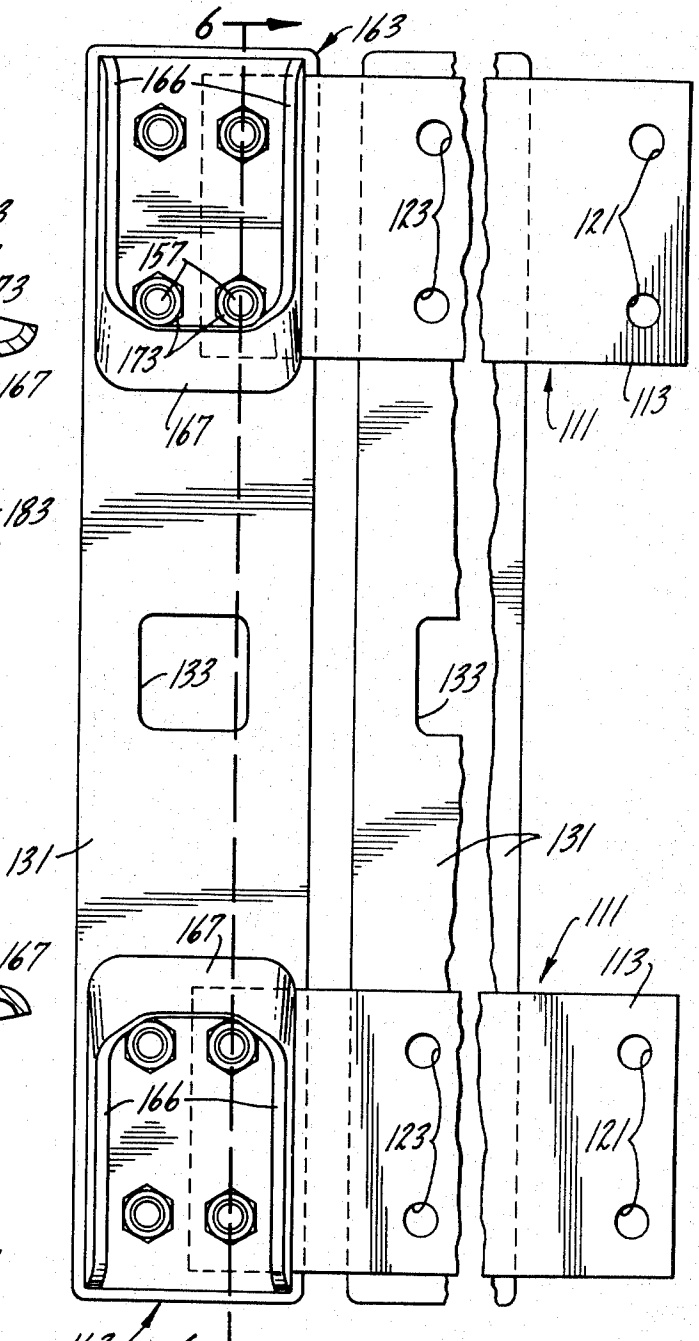

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Fig. 5.

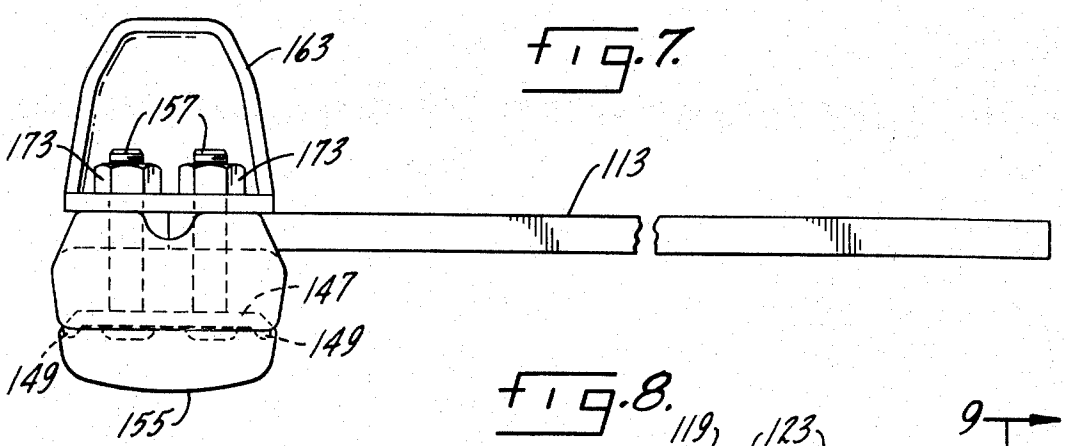


fig. 7.

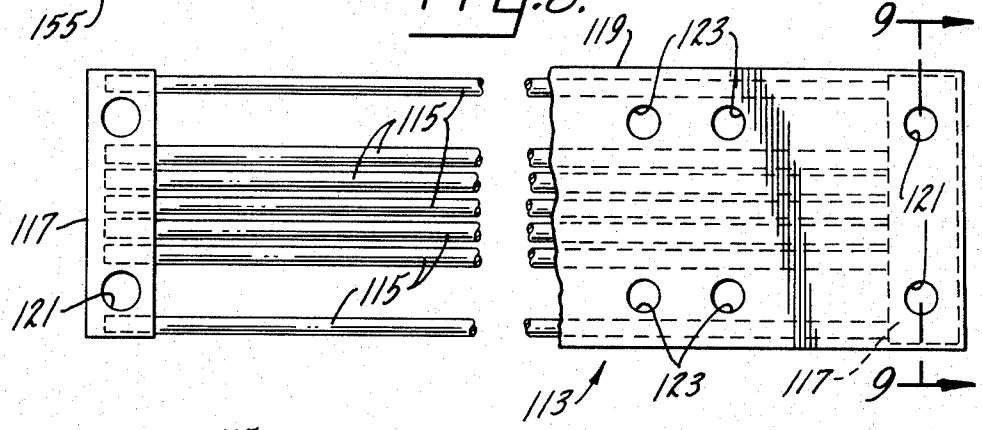


fig. 8.

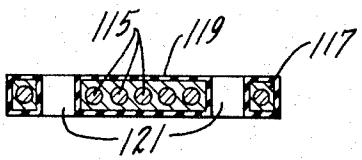


fig. 9.

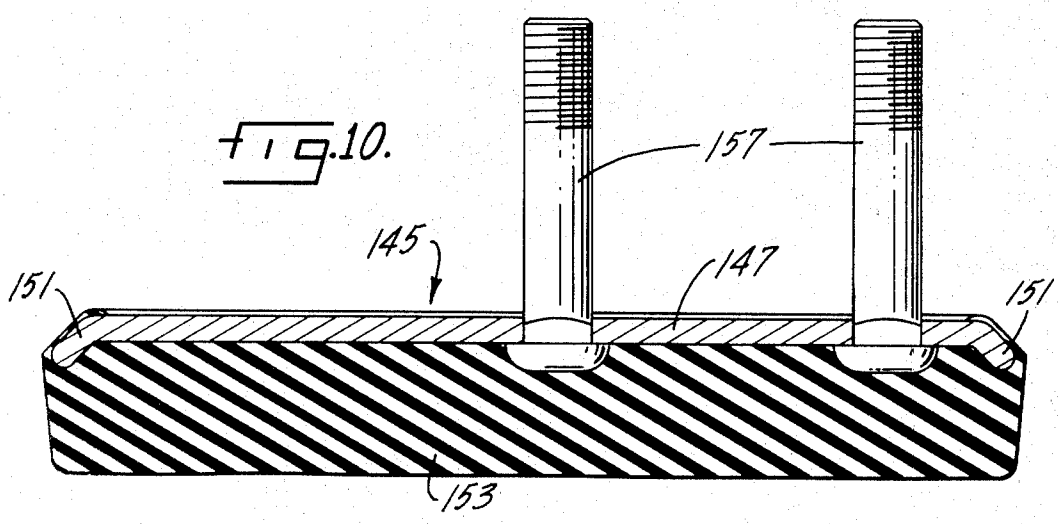


fig. 10.

Fig. 11.

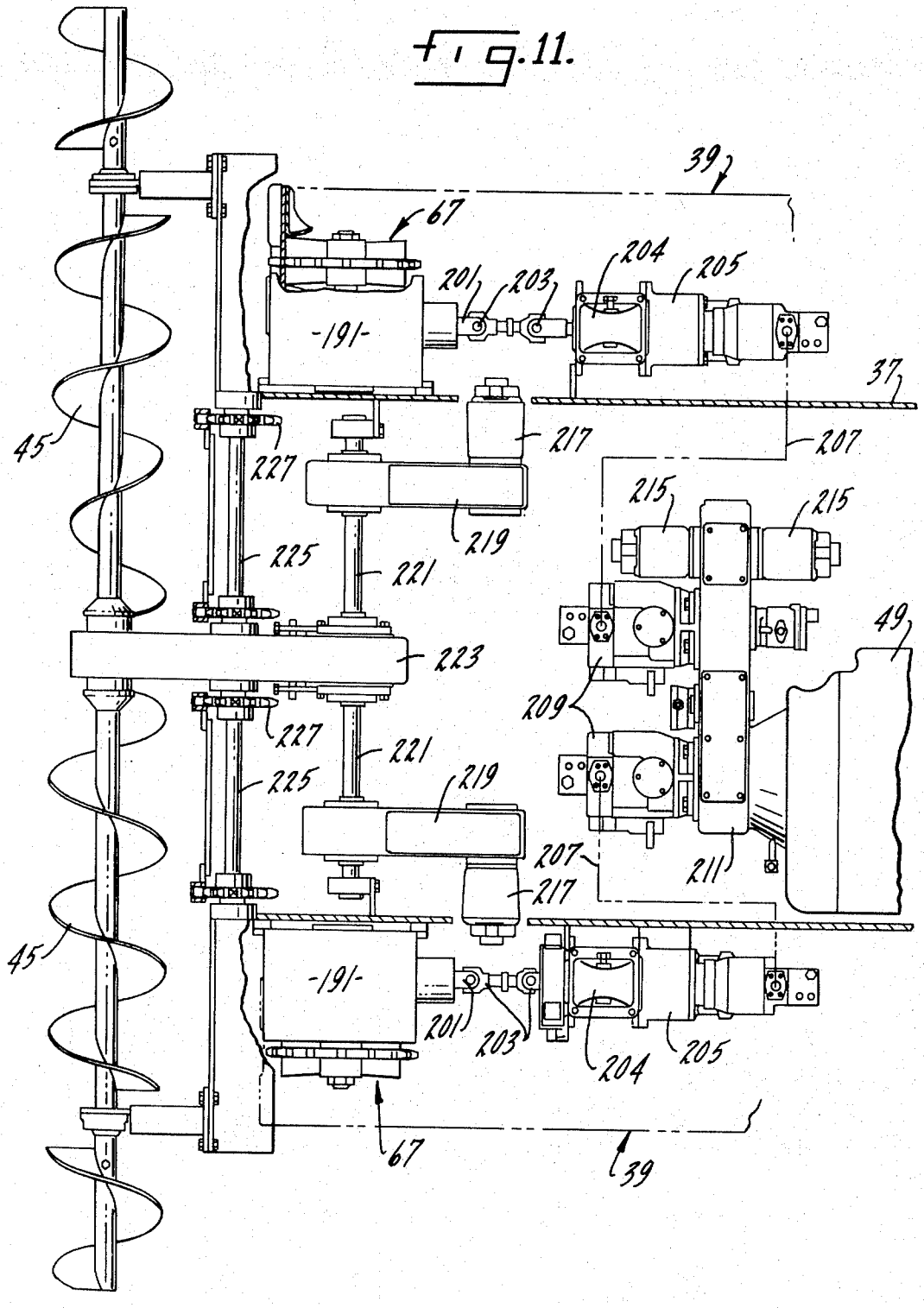
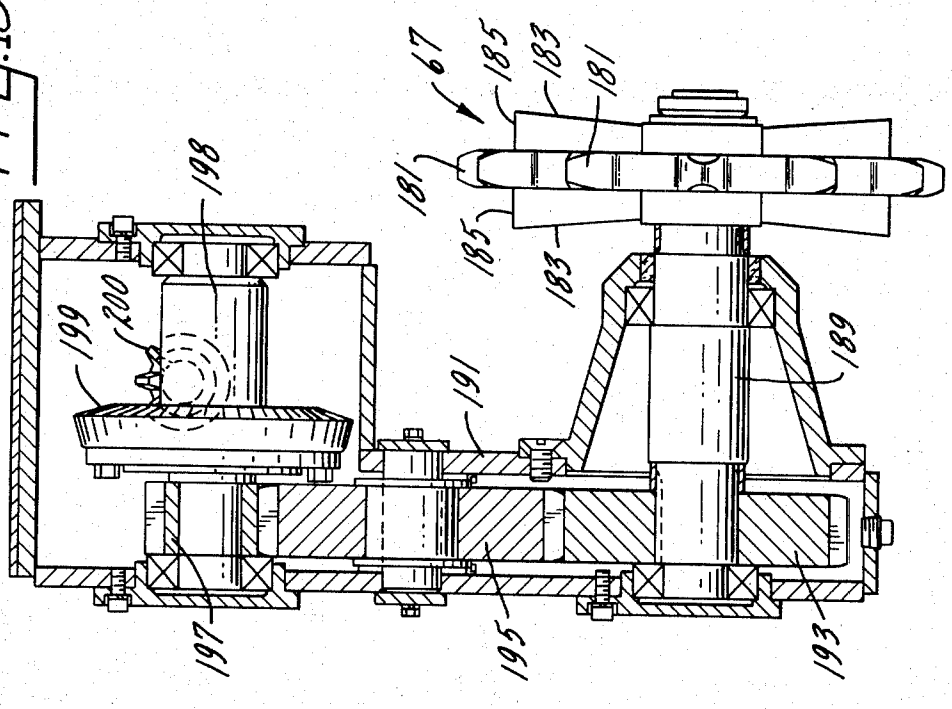

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FIG. 13.


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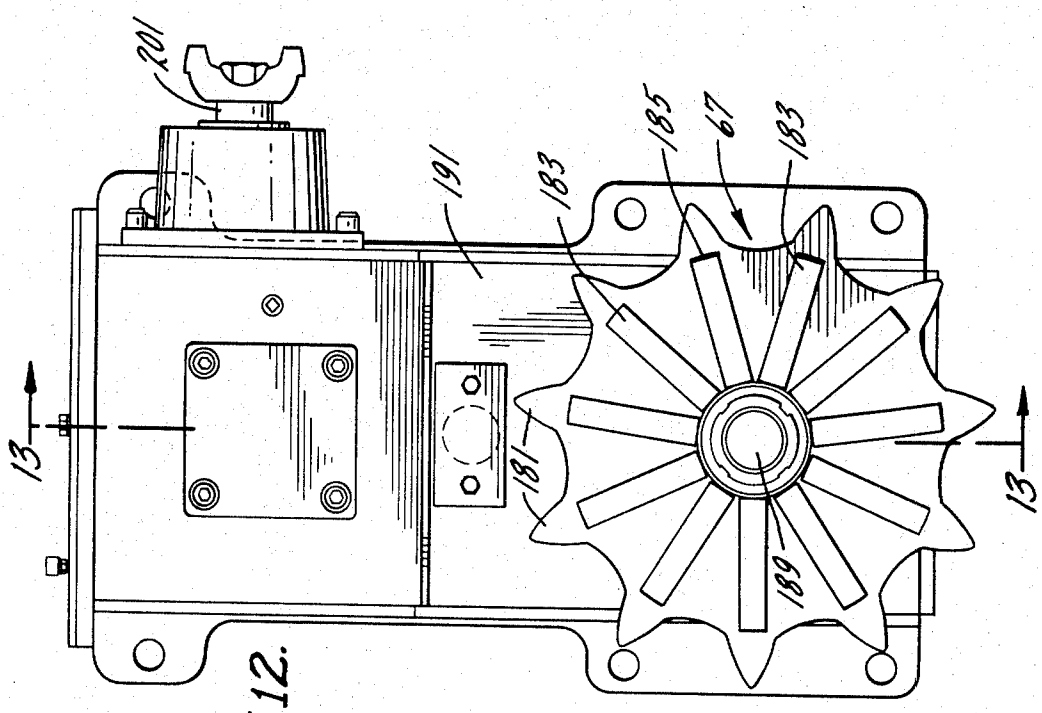
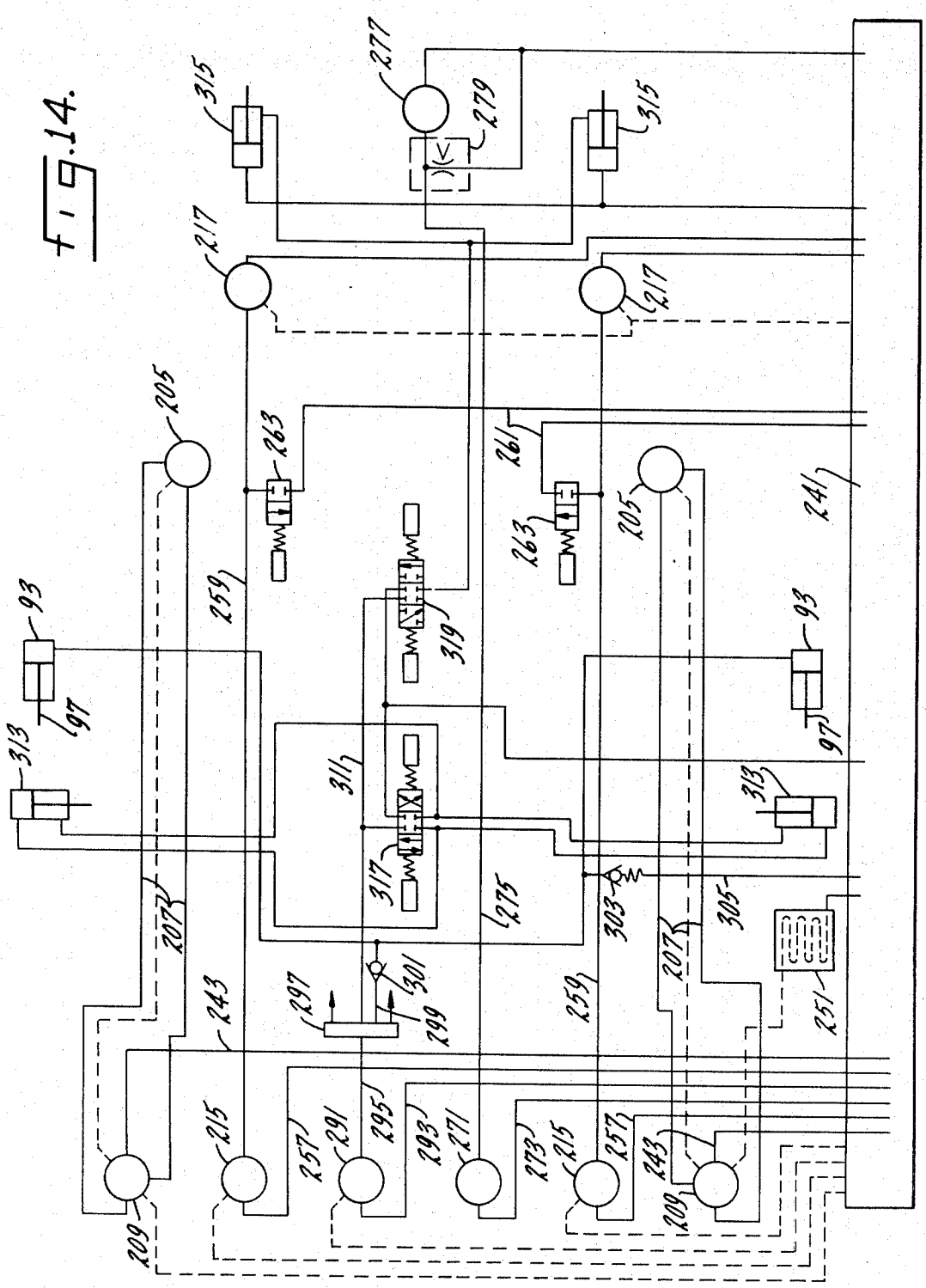

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FIG. 12.

FIG. 14.


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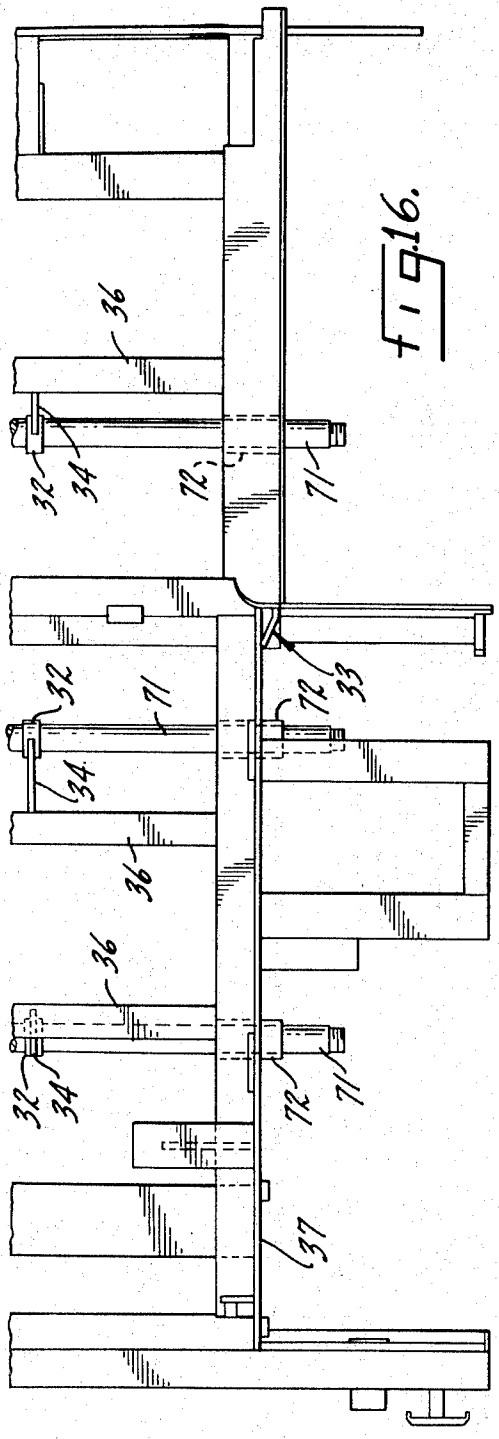

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FIG. 16.

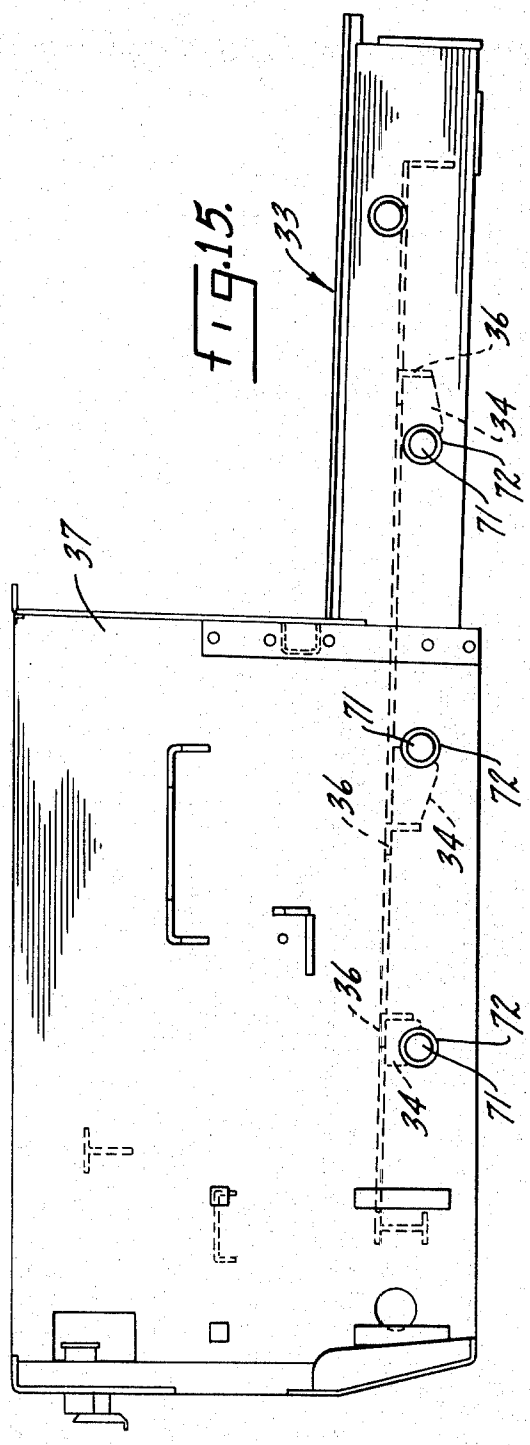
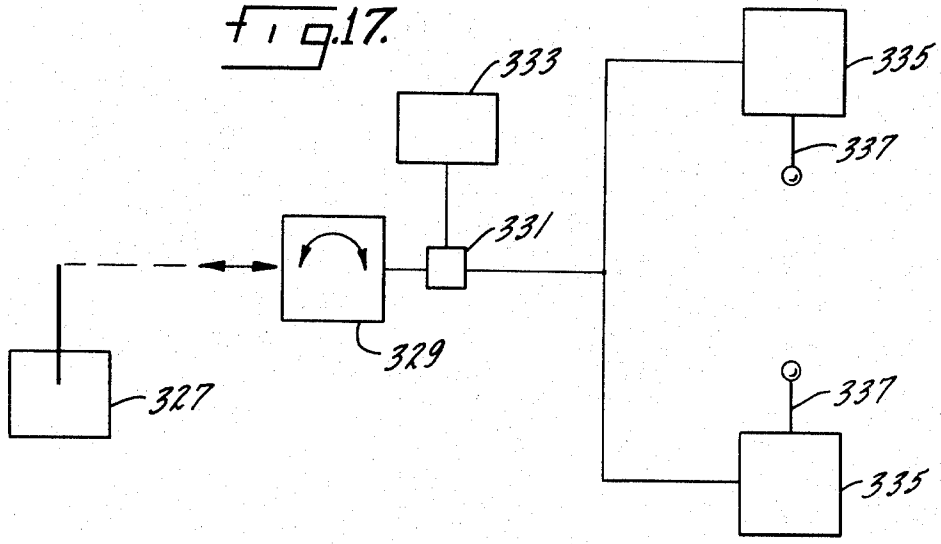

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FIG. 15.

Fig. 17.



PAVING MACHINE

This is a division of application Ser. No. 889,542, filed Dec. 31, 1969 and now U.S. Pat. No. 3,700,288.

SUMMARY OF THE INVENTION

This invention is concerned with an asphalt paving machine and more particularly with a paving machine having track means to move the paving machine along a supporting surface.

An object of this invention is an asphalt paving machine having rubber tread track means.

Another object is a paving machine having track means which are individually driven.

Another object is a paving machine having track means which are individually driven by separately controlled hydrostatic transmissions.

Another object is a paving machine having track means which are uniformly tensioned by hydraulic mechanisms.

Another object is a paving machine having tracks driven by sprockets in which the drive train for each sprocket is totally enclosed.

Another object is a paving machine having tracks driven by sprockets in which the sprockets are gear driven by hydrostatic motors.

Another object is a tracked paving machine which may be pivoted about its center line.

Another object is a paving machine having a pair of tracks with a six point suspension system between the tracks and the torsionally flexible frame of the paving machine.

Another object is a paving machine having tracks in which the track drive sprockets support the track shoes and bands to maintain constant pitch diameters of the tracks.

Another object is a paving machine having a closed center hydraulic system for operating hydraulic actuators.

Another object is a paving machine having a manual automatic engine speed control in which the engine is brought to its idle speed when the paving machine is stopped and is automatically brought to its governed speed whenever the paving machine is moved.

Another object is track means for a paving machine or the like utilizing shoes connected to bands.

Another object is an endless track for a land vehicle which does not utilize pins to connect the shoes.

Another object is an endless track having metal shoes with replaceable rubber inserts.

Another object is an endless track in which the track retaining means are formed as separate parts connected to the shoes.

Another object is an endless track having shoes connected to bands in which the bands are made in sections.

Another object is an endless track guided on bogie wheels in which the side loads from the bogie wheels are transferred directly to the shoes.

Another object is a paving machine having an endless track in which the bogie wheels engaging the track are mounted in pairs on carriages which pivot about the paving machine frame

Other objects may be found in the following specification, claims and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated more or less diagramatically in the following drawings wherein:

FIG. **1** is a side elevational view of a paving machine embodying the novel features of this invention;

FIG. **2** is an enlarged, perspective, partial view of the track mechanism of this invention with parts broken away and others omitted for clarity of illustration;

FIG. **3** is an enlarged partial plan view of the track mechanism of FIG. **2** with some parts broken away and others shown in phantom;

FIG. **4** is an enlarged cross-sectional view taken along line **4—4** of FIG. **3**;

FIG. **5** is an enlarged, partial plan view of a section of track;

FIG. **6** is a cross-sectional view taken along line **6—6** of FIG. **5**;

FIG. **7** is a partial side elevational view of a section of track;

FIG. **8** is a plan view of a track band section with parts broken away and others omitted for clarity of illustration

FIG. **9** is a cross-sectional view taken along line **9—9** of FIG. **8**;

FIG. **10** is a vertical cross-sectional view of a track shoe insert;

FIG. **11** is a partial plan view of the drive mechanisms of the paving machine;

FIG. **12** is a side elevational view of the track driving sprocket and its gear housing;

FIG. **13** is a cross-sectional view taken along line **13—13** of FIG. **12**;

FIG. **14** is a schematic diagram of the hydraulic system of the paving machine;

FIG. **15** is a side elevational view of the paving machine frame;

FIG. **16** is a top plan view of one half of the paving machine frame; and

FIG. **17** is a schematic diagram of the paving machine engine speed control.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** of the drawings shows a paving machine **31** embodying the novel features of this invention. The paving machine includes a frame **33** on which is mounted a hopper **35** and a body **37.** The paving machine rides on a pair of endless track means **39.** Screed arms **41** mounted on the paving machine support a screed **43** located at the rear of the paving machine. Auger conveyors **45** are mounted forwardly of the screed. Truck push rollers **47** are mounted on the frame **33** forward of the hopper **35.** The paving machine is powered by an engine **49** mounted on the body **37.**

The endless track means of this invention are shown in more detail in FIGS. **2** through **10** of the drawings. FIG. **2** of the drawings shows a portion of the right hand endless track means. The endless track means **39** includes a track **61** which is guided around bogie wheels **63,** a tensioning wheel **65** and a drive sprocket **67.** Each pair of bogie wheels **63** is connected to the opposite ends of an elongated bogie carriage **69** which is journaled about a shaft **71.** The shafts **71** extend across the paving machine and are affixed to sleeves **72** attached to the frame **33.** See FIGS. **15** and **16.** The shafts are

supported near the center of the frame by collars **32** affixed to brackets **34.** The brackets are attached to transversely extending angle **36.** It should be noted that the frame **33** has no diagonal cross-bracing and this contributes to its torsional flexibility.

Referring particularly to FIGS. **3** and **4,** each bogie wheel **63** includes a rim **73** mounted on a stub shaft **75** which is affixed to one end of the bogie carriage **69.** A pair of hard rubber tires **77** are affixed to the rim **73** and are spaced laterally from each other.

The tensioning wheel **65,** shown in FIGS. **2** and **3,** include a rim **81** on which is mounted a pair of laterally spaced rubber tires **83.** The tensioning sheel rim is journaled on a stub shaft **85** which is connected to a crank **87.** The crank **87** is pivotally connected by a stub shaft **88** fixed to rotate within a sleeve **90** which is attached to the frame **33.** The upper portion of the crank **87** is covered by a housing **89** (FIG. **3**). This housing is formed as part of a bracket **91** which is fastened to the frame **33.** A hydraulic cylinder and piston **93** is pivotally connected at one end by pivot pin **95** to the bracket **91.** The piston rod **97** of the hydraulic cylinder **93** has an arcuate shaped seat **99** which engages the stub shaft **85** of the tensioning wheel **65.**

The track **61** is shown in detail in FIGS. **4** through **10,** inclusive. Referring to FIGS. **5** and **6,** the track includes a pair of bands **111,** each of which is composed of a number of band sections **113** joined end to end. A typical band section is shown in detial in FIGS. **8** and **9.** Each band section includes a number of steel cables **115** which are imbedded at their ends in anchor plates **117.** The cables and anchor plates are encased in a rubber substance **119.** Openings **121** are formed extending through the rubber and anchor plates **117** and openings **123** are formed through the rubber casing. The band sections **113** interconnect a plurality of shoes **131** to form the track **61.**

The shoes **131** are shown in detail in FIGS. **5, 6** and **7.** Each shoe **131** is a generally rectangular, elongated metal member having a centrally located sprocket opening **133.** A pair of planar bogie tire engaging surfaces **135** are located on opposite sides of the sprocket opening **133** on the inside surface of the shoe. Channels **137** are formed in the shoe at the ends thereof to receive the band sections **113** in the manner shown in FIG. **6.** Upstanding ribs **139** are formed on the shoes on opposite sides of the channels **137.**

Connected to each shoe is a pair of rubber pad inserts **145** which are shown in detail in FIGS. **6, 7** and **10.** Each insert consists of a flat, generally rectangular metal plate **147** having downturned side edges **149** and downturned end edges **151.** A rubber pad **153** is molded to the under surface of the plate **147** and extends over the upper surfaces of the downturned edges **149** and **151** to cover a small part of the planar upper surface of the plate **147.** The details of the insert are best shown in FIG. **10.** It should also be noted that the downturned edges **149** and **151** of the plate **147** extend at an angle of about 45° with the planar portion of the plate. As can best be seen in FIG. **7,** the rubber pad **153** has a convex wearing surface **155.** Bolts **157** extend through plate **147** from the underside thereof with the heads of the bolts engaging the plate.

Retainers **163** are connected to opposite ends of each shoe **131.** The retainers are shown in detail in FIGS. **5, 6** and **7.** Each retainer has a generally planar surface **165** which engages and rests on the upstanding ribs **139** to span the channels **137** formed in the shoes. Each retainer has an upstanding generally U-shaped wall **166.** The wall has a surface **167** which is positioned to face the sprocket opening **133** of the shoe **131.** This surface is sloped generally outwardly from the planar surface **165.** A downwardly extending lip **169** is formed on the retainer at the base of the surface **167** and engages the inner upstanding rib **139** to transfer side loads exerted against the retaining member directly to the shoe **133.** Bolt openings **171** are formed through the planar surfaces **165** of the retainers. The bolts **157** of the rubber pad inserts **145** extend through openings **141** in the shoes, openings **121** and **123** in the band sections **113** and bolt openings **171** in the retainers and receive nuts **173** to fasten the shoes, retainers inserts, and band sections into the track unit **61.**

The drive sprocket **67** is shown in detail in FIGS. **2, 12** and **13.** The sprocket is formed with a plurality of teeth **181** adapted to mesh with the sprocket openings **133** in the shoes **131** as shown in phantom in FIG. **6.** Formed on the sides of the sprocket and located radially inwardly of the teeth **181** are radially extending segments **183** having end surfaces **185** which form an interrupted rim on each side of the sprocket. As can be seen in FIG. **6,** the rim surfaces **185** engage the planar surfaces **135** on the shoes **131** when the teeth **181** mesh in the openings **133** of the shoes.

Referring to FIG. **13,** the sprocket **67** is mounted on a shaft **189** which is journaled on bearings in the transmission housing **191.** A gear **193** affixed to the opposite end of shaft **189** meshes with idler gear **195.** Idler gear **195** meshes with gear **197** affixed to shaft **198** which is journaled on bearings in the transmission housing. Bevel gear **199** affixed to shaft **198** engages a pinion gear **200** at the end of input shaft **201.**

The input shaft **201** to the transmission housing shown in FIGS. **11** and **12** is connected by universal joints **203** to a three speed transmission **204** which connects to a hydrostatic traction motor **205.** As seen in FIG. **11,** a separate drive sprocket **67,** transmission **24** and hydrostatic traction motor **205** are provided for each endless track means **39.** Each hydrostatic traction motor **205** is provided with hydraulic fluid under pressure through conduits **207** leading from separate traction pumps **209.** The traction pumps **209** are driven by the paving machine engine **49** through a suitable transmission **211.**

The engine **49** also drives the right hand and left hand auger conveyor pumps **215** through the transmission **211.** These pumps supply hydraulic fluid under pressure to the auger conveyor hydrostatic drive motors **217** through conduits **259** (FIG. **14**). The right and left hand auger conveyors **45** are driven by the drive motors **217** through the reduction gears **219,** drive shafts **221** and chain drive **223.** With this arrangement, the drive for each auger conveyor **45** is independent of the drive for the other auger conveyor. The chain drive **223** also drives shafts **225** on which are mounted sprockets **227** which drive the slat conveyors (not shown). The slat conveyors carry the paving material from the hopper **35** to the auger conveyors **45.**

FIG. **14** is a schematic drawing of the hydraulic systems of the paving machine. The hydraulic systems use a common hydraulic fluid reservoir **241.** The traction pumps **209** obtain their hydraulic fluid from this reservoir through the suction conduits **243.** The traction pumps **209** are of the axial piston type. These pumps

supply hydraulic fluid to the traction motors **205** also of the axial piston type, through conduits **207.** The hydraulic fluid used in the pumps **209** is cooled by a cooler **251.**

Auger conveyor pumps **215** obtain hydraulic fluid from the reservoir **241** through suction conduits **257.** The hydraulic fluid from the pumps **215** is supplied to the auger conveyor motors **217** through conduits **259.** Connected in parallel with these conduits and the auger motors **217** are reservoir return conduits **261** controlled by solenoid operated valves **263.**

A hydraulic pump **271** takes hydraulic fluid from the reservoir **241** through a conduit **273** and delivers the hydraulic fluid through conduit **275** to a hydraulic motor **277** which drives a screed vibrator (not shown). An adjustable orifice bypass **279** is provided around the motor **277.**

A variable volume, constant pressure pump **291,** obtains hydraulic fluid through conduit **293** from the reservoir **241.** It supplies hydraulic fluid through a conduit **295** to a manifold **297.** A number of conduits lead from this manifold. Among them is conduit **299** which splits into two branches and supplies hydraulic fluid to the track tensioning cylinders **93.** A check valve **301** is provided in this conduit to prevent the backflow of hydraulic fluid from the cylinders to the manifold. A relief valve **303** is located in a conduit **305** connecting conduit **299** with the reservoir. The relief valve **301** is set to operate at a pressure slightly higher than the normal operating pressure of the hydraulic fluid in conduit **299.**

A conduit **311** leading from the manifold **297** supplies hydraulic fluid to the hopper lift cylinders **313** and the screed lift cylinders **315** through solenoid operated directional control valves **317** and **319.**

FIG. **17** is a schematic illustration of a speed control mechanism for the paving machine engine **49.** Box **327** represents the engine throttle which may be a shaft or an arm. Box **329** represents a linear actuator which may be either a hydraulic cylinder or a cylinder operated by the engine vacuum. An electrically operated valve **331** controls the flow fo fluid from a reservoir **333** to the linear actuator. The electric valve **331** is controlled by electrical limit switches **335** which are opened and closed by movement of the hydrostatic transmission control levers **337.**

The use, operation and function of this invention are as follows:

The paving machine **31** of this invention is characterized by rubber tread tracks which are individually driven by separately controlled hydrostatic transmissions. The endless track means **39** of the paving machine is long wearing, permits high travel speed and increases the draw bar power of the paving machine while reducing maintenance and repair. The independent hydrostatic drive for each track enables the paving machine to be steered easily and provides infinitely variable power to each track. The independently variable hydrostatic drive for each track also permits the paving machine to be turned about its center line and enables the machine to pave smoothly around curves, eliminating all jogs.

The flexibility of the power train is further enhanced by the provision of the three speed transmissions **204** between the traction motors **205** and the drive sprockets **67.** The shifting of this transmission, as the speed of the paver varies, maintains the hydraulic fluid being supplied to the traction motors **205** at the lowest pressure and highest volume for a given paver speed, thus maintaining maximum performance and efficiency.

Equal tension is maintained in each track by the hydraulic actuators **93.** These actuators are supplied with hydraulic fluid through a common conduit **299** from the hydraulic fluid manifold **297.** This improves the ability of the paving machine to travel in a straight line. The relief valve **303** provides an automatic release when the hydraulic pressure reaches a preselected setting.

The track **61** of this invention has been designed to eliminate or reduce wear and to provide for ease of maintenance and replacement of broken and worn track. The track **61** consists of four main replaceable components. These are the band sections **113,** shoes **131,** rubber pad inserts **145** for the shoes and retainers **163.** The bolts **157** and nuts **173** which hold the inserts onto the shoes also connect the shoes and retainers to the band sections **113** and connect the band sections together in an endless band **111.** As is shown in FIG. **5,** band sections **113** connect at their ends to a pair of bolts of a common shoe to form the endless band **111.** Thus, replacement and repairs of broken or worn parts in a track **61** can be accomplished simply by loosening the nuts **173** and removing the insert pad **153** and their attached bolts **157.**

The retainers **163,** which engage the bogie wheels **63** to maintain the track in alignment, are designed to cooperate with the upstanding ribs **139** on the shoes to control the clamping action of the band sections **113** to the shoes. This construction eliminates the need for providing spacers on the mounting bolts and thus permits the diameter of the mounting bolts to be increased. The retainers and shoes are also designed so that side loads applied to the retainers are transferred directly to the shoes through the lips **169** on the retainers and the ribs **139** on the shoes. This eliminates the application of the side loads to the track shoe insert mounting bolts **157.**

The provision of a pair of hard rubber tires **71** spaced apart on the rims **73** of each bogie wheel **63** enables the tires to ride on the planar portions **135** of the shoes **131** and to straddle the sprocket tooth openings **133** formed in the shoes. The use of two spaced tires on each bogie wheel reduces heat build up and eliminates the hard rubber of the tires from being forced or drawn through the sprocket openings. The bogie wheels **63** also provides support for the tracks **61** during both their upper and lower paths of travel around the sprockets and tensioning wheels. The tensioning wheels are provided with pairs of hard rubber tires **83** for the same reasons.

The attachment of the pairs of bogie wheels **63** to the pivotally mounted carriages **69** allows the tracks to pass over obstructions without tilting or tipping the paving machine. The pivoting of the carriages is limited by stops (not shown) attached to the frame **33.** To provide additional flexibility of the track means the bogie carriages are mounted on shafts **71** which extend across the vehicle and are fastened to the frame. In effect, this provides a six point suspension for the bogie wheels. Thr frame **33** is built without diagonal cross-bracing to be torsionally flexible to accomodate this type of mounting.

To reduce the transmission maintenance and to protect it against damage, the gear trains between the three speed transmissions **204** and the sprockets **67** are

completely enclosed in housings **191.** This construction eliminates open chain drives and the problems inherent with such drives. In addition to driving the tracks **61,** the drive sprockets **67** engage and support the track shoes **131** through means of the segmented rims **185** which engage the planar surfaces **135** on the shoes. The sprockets therefore maintain a constant pitch diameter for the tracks and eliminates side roll of the tracks as they go around the drive sprockets.

The closed center hydraulic system includes the variable volume, constant pressure pump **291** and the manifold **297.** This pump, which is a pressure compensated pump, delivers a variable volume of hydraulic fluid. The volume delivered by the pump increases as the demand increases and decreases and the demand decreases. Although the output volume of the pump varies, the pressure remains constant. Hydraulic fluid is supplied to each actuator independently from the manifold. The advantage of the closed center system is that the hydraulic fluid is available at a predetermined pressure to any one of the actuators, independent of any of the other actuators.

The engine speed control mechanism shown in FIG. **17** automatically brings the speed of the engine **47** from idle to full operating speed and from full operating speed to idle automatically upon movement of either the hydrostatic transmission speed control levers **337.**

We claim:

1. A crawler-type land vehicle, such as a paving machine, having a pair of endless tracks to move said machine across a supporting surface; said machine having no resilient suspension between the frame therefor and said pair of tracks; the combination which comprises a pair of longitudinally extending side frame members; a plurality of cross frame members extending transversely between said side frame member; said side frame members and said cross frame members forming a frame structure free of diagonal cross bracing and having substantial torsional flexibility; a plurality of shafts non-resiliently supported in said frame structure and extending from the exterior of one side of one of said longitudinally extending side frame members to the exterior of the other of said pair of side frame members; an elongated carriage pivotally mounted on each end of each shaft; a pair of bogie wheels, each non-resiliently mounted on each end of each carriage; and said bogie wheels being engageable with said endless track on each side of said vehicle.

2. The apparatus of claim **1** further characterized in that each carriage is free to pivot independently of the carriage mounted on the opposite end of its shaft.

3. The apparatus of claim **1** further characterized in that three shafts are mounted on said frame.

4. The apparatus of claim **1** further characterized in that each bogie wheel contacts the endless track means along the upper and lower paths of travel of said track means.

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