

US00RE40484E

(19) **United States**
(12) **Reissued Patent**
Kelly et al.

(10) **Patent Number:** **US RE40,484 E**
(45) **Date of Reissued Patent:** **Sep. 9, 2008**

(54) **TRACKING, PROPULSION AND BRAKING SYSTEM FOR BRIDGE TRIPPER/HOPPER CAR**

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(21) Appl. No.: **10/150,598**

(22) Filed: **May 17, 2002**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **6,098,780**
Issued: **Aug. 8, 2000**
Appl. No.: **09/131,265**
Filed: **Aug. 7, 1998**

(51) **Int. Cl.**
B65G 37/00 (2006.01)
B61H 13/00 (2006.01)

(52) **U.S. Cl.** **198/364**; 198/585; 198/356;
104/246; 105/96.1

(58) **Field of Classification Search** 198/364,
198/585, 356; 104/245, 246, 247; 105/96,
105/96.1, 163.1, 163.2; 180/65.5, 65.6; 188/33,
188/35, 38, 41, 157

See application file for complete search history.

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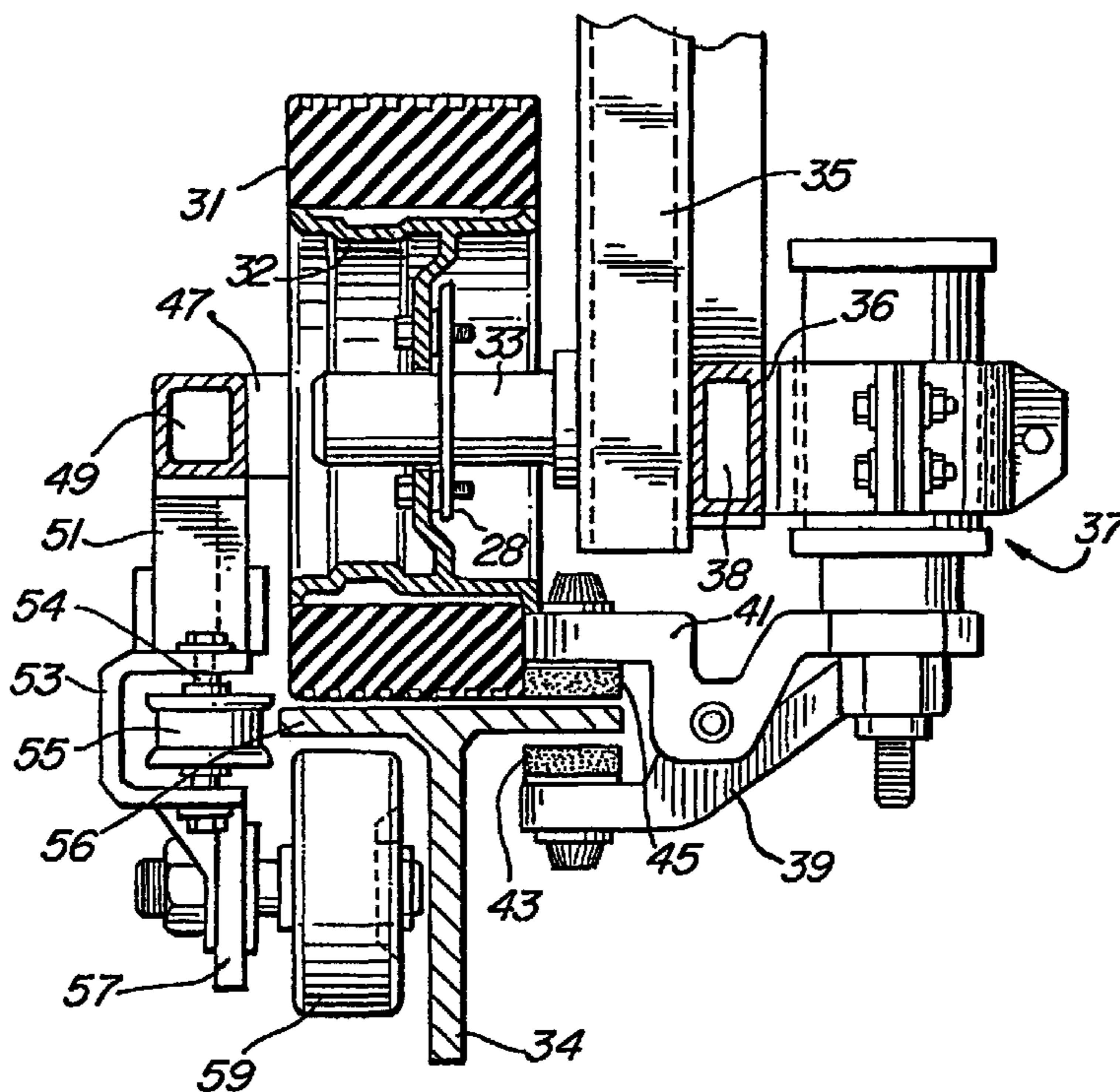
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Primary Examiner—Douglas A Hess

(57) **ABSTRACT**

A tripper/hopper car rides on a conveyor via four wheel tires running on T-section rails, with respective hold down wheels riding adjacent the underside of the rails and respective caster side wheels riding adjacent the vertical edges of the T-rails. Each wheel tire is driven by a motor drive unit employing a shaft-mount gearbox with a motor brake that utilizes the reduction of the drive gearbox to increase the effective braking torque developed. A pair of caliper-type brakes is further provided for redundancy.

26 Claims, 6 Drawing Sheets



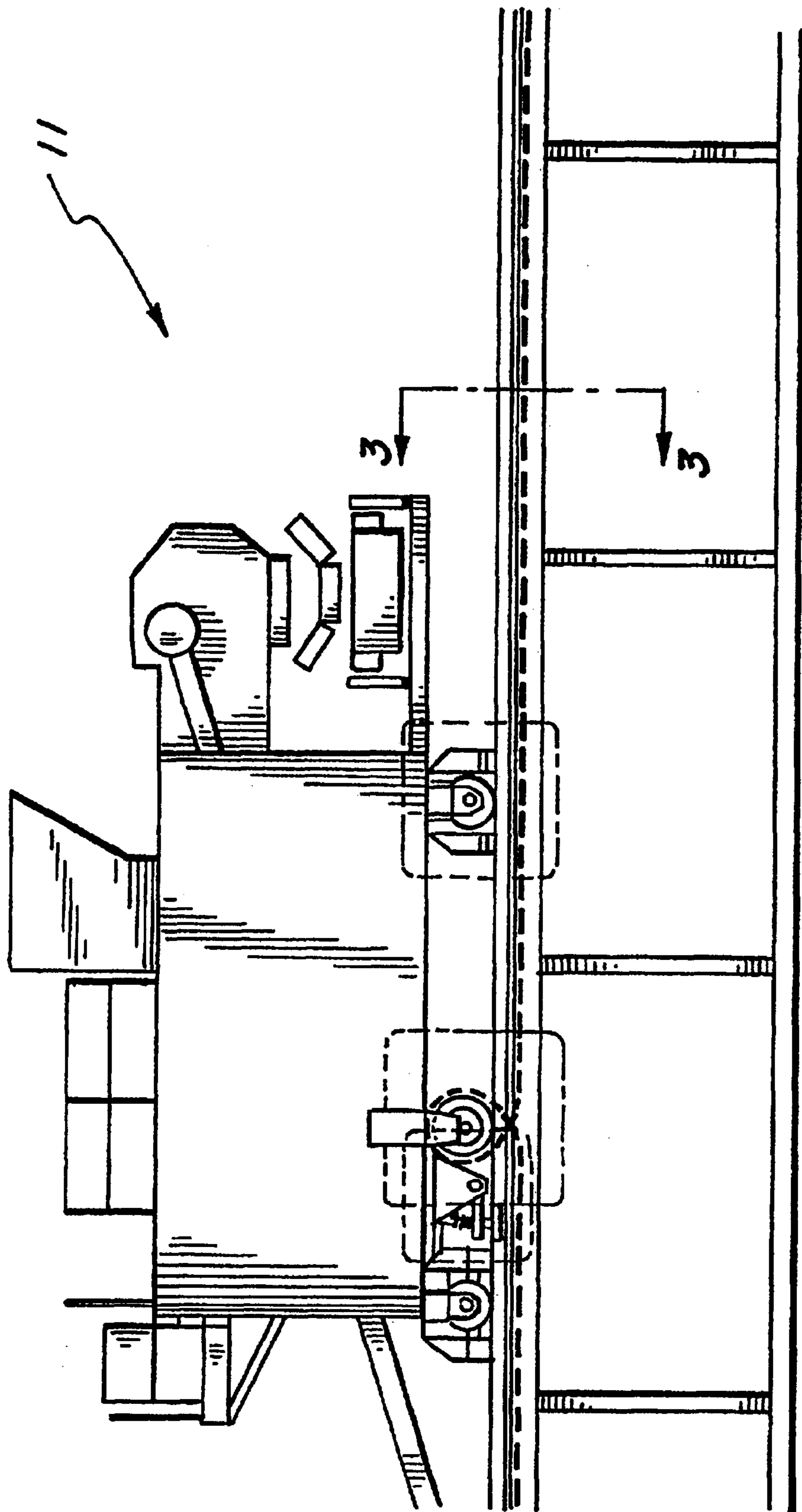


FIG. 1
PRIOR ART

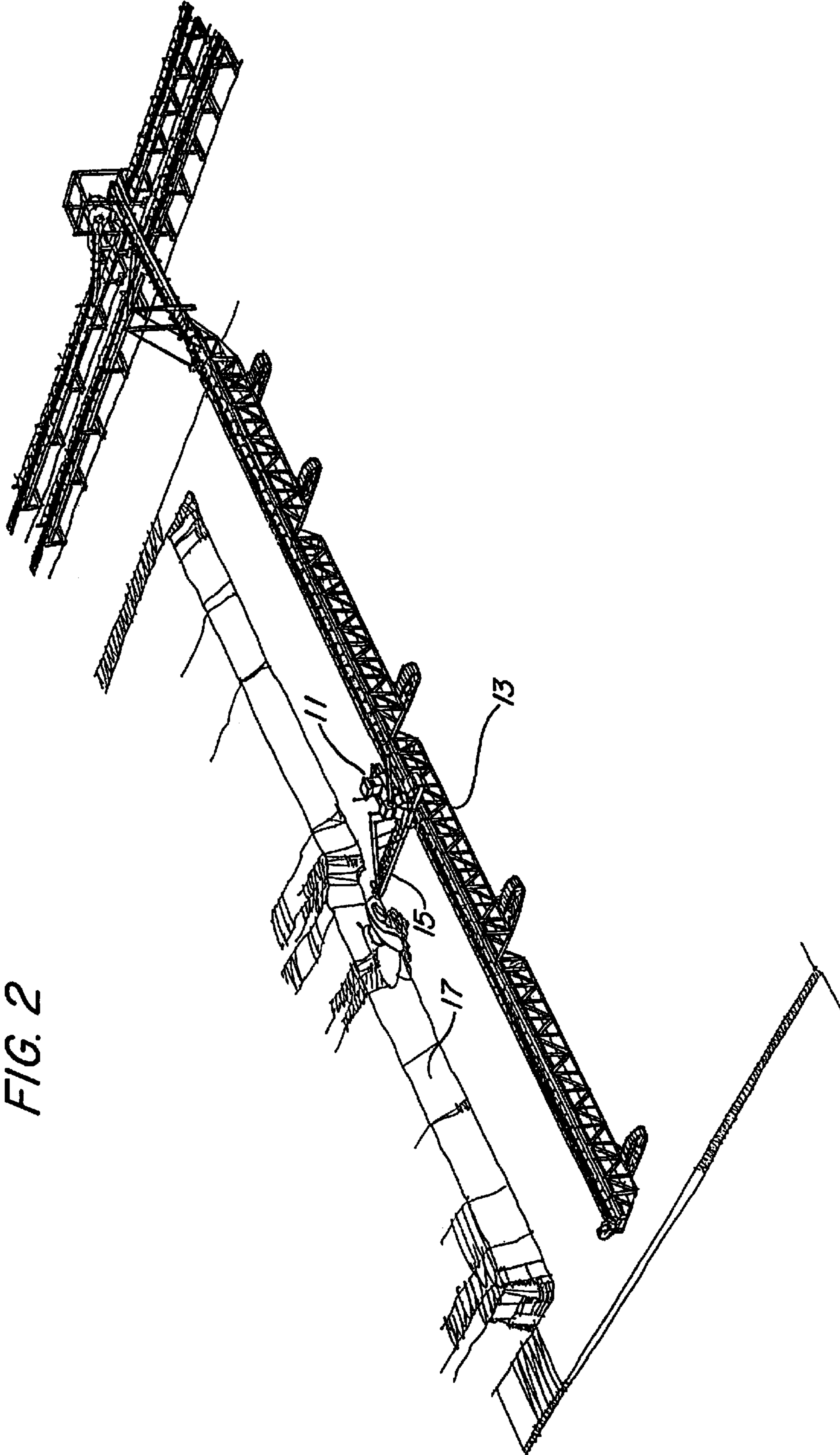


FIG. 2

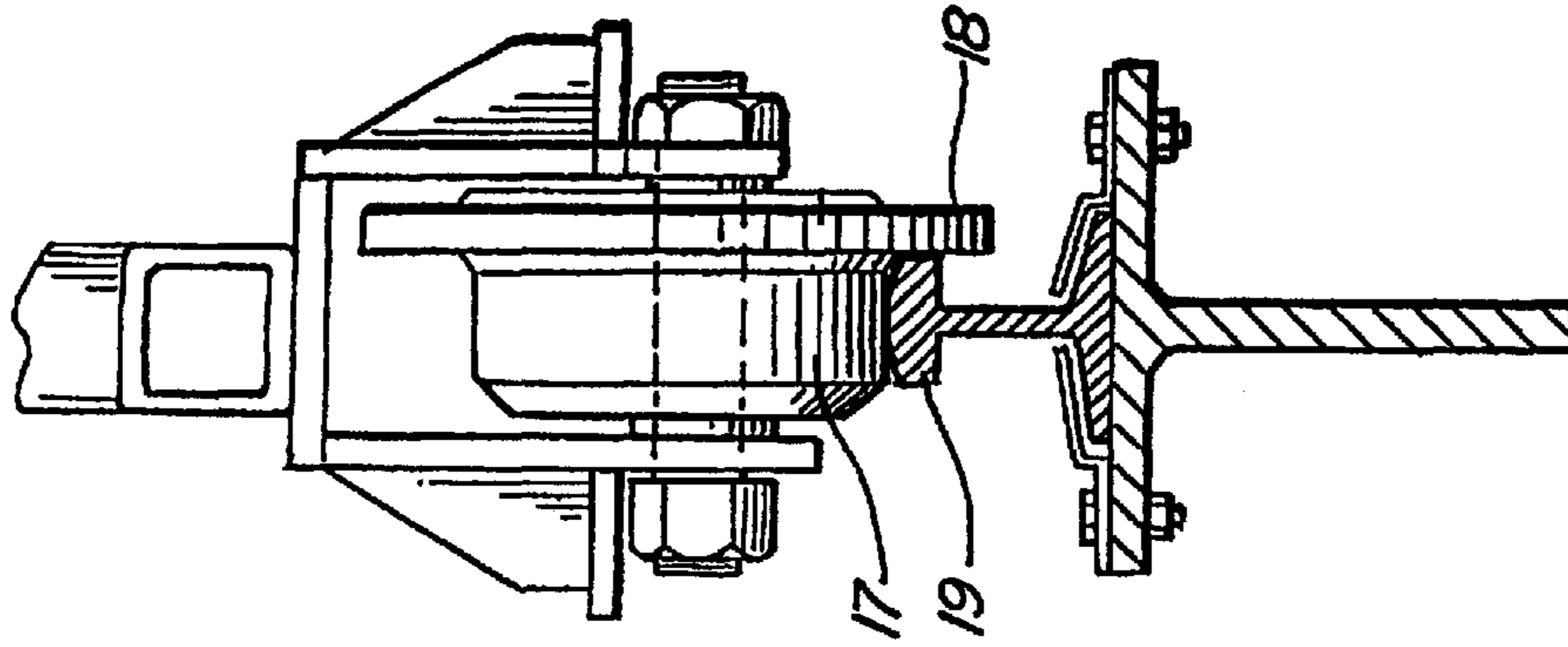


FIG. 3
PRIOR ART

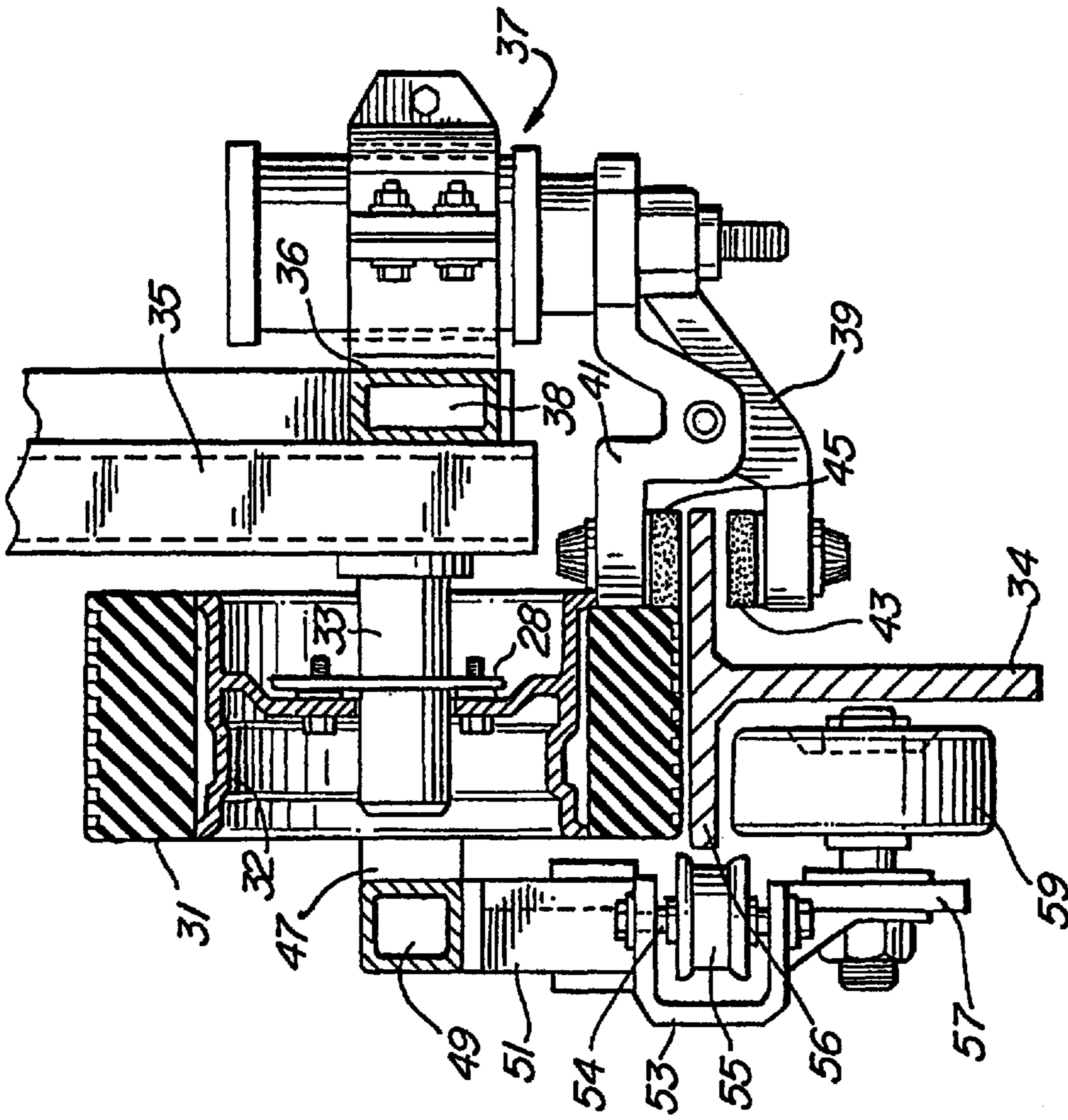


FIG. 5

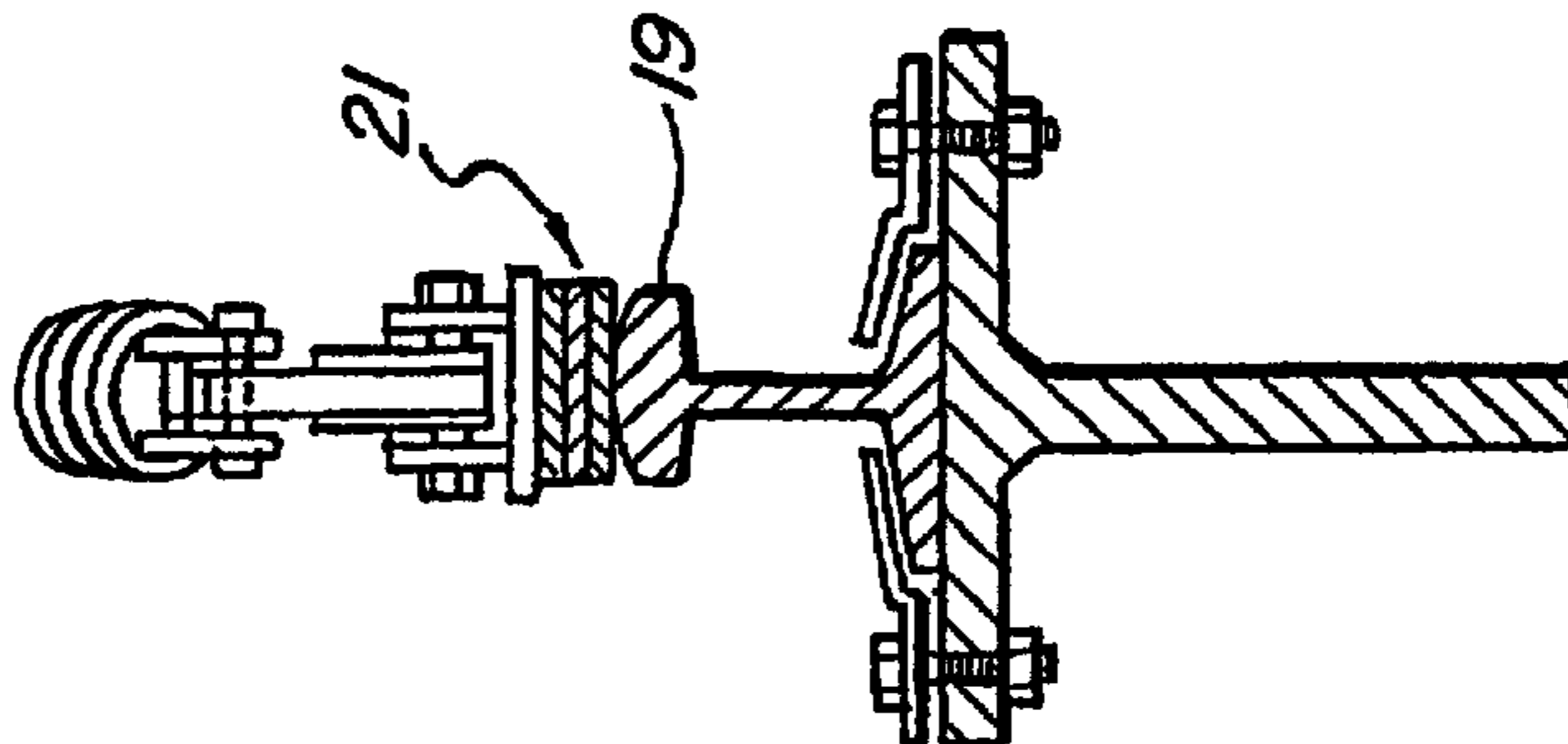


FIG. 4
PRIOR ART

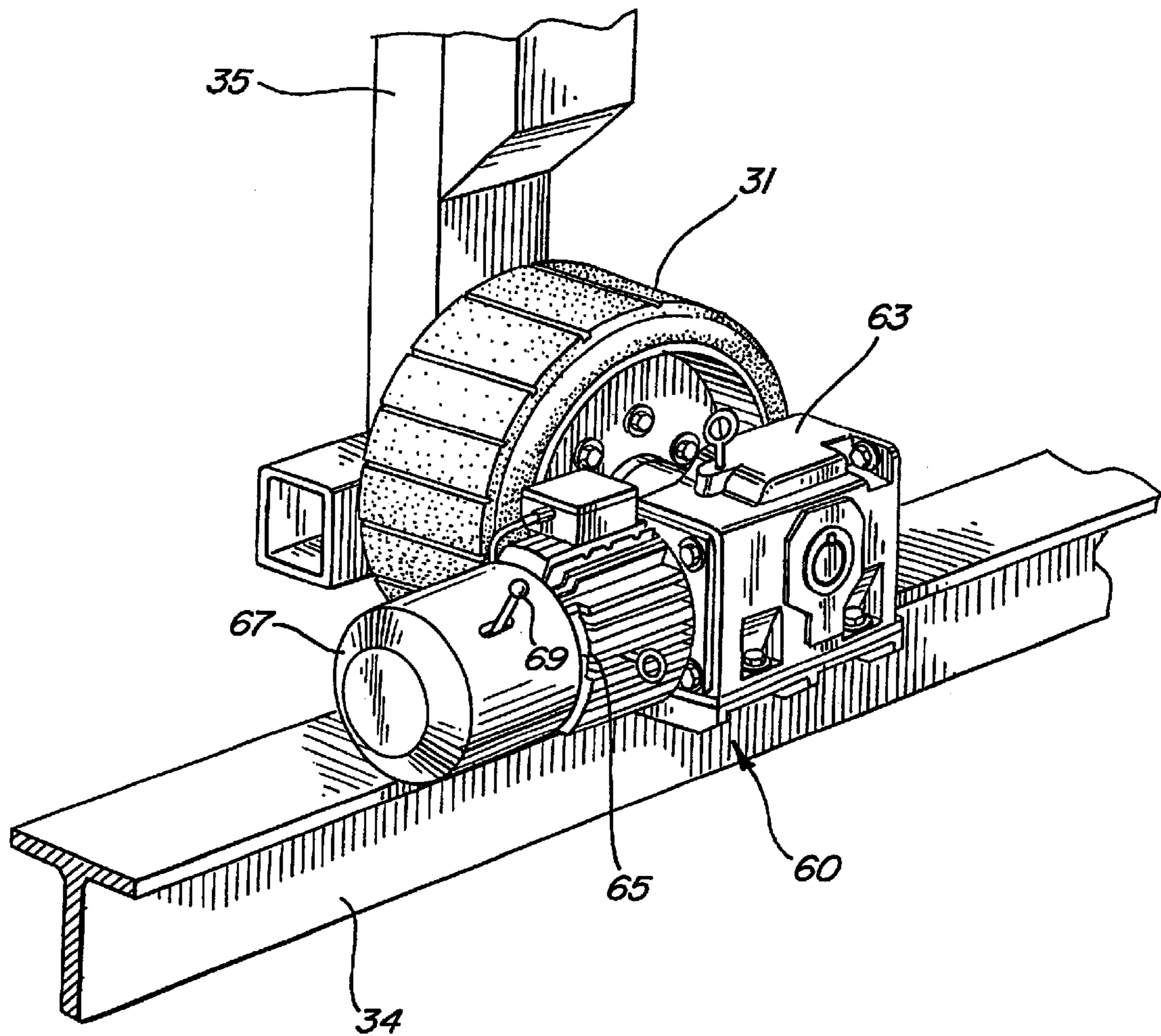


FIG. 6

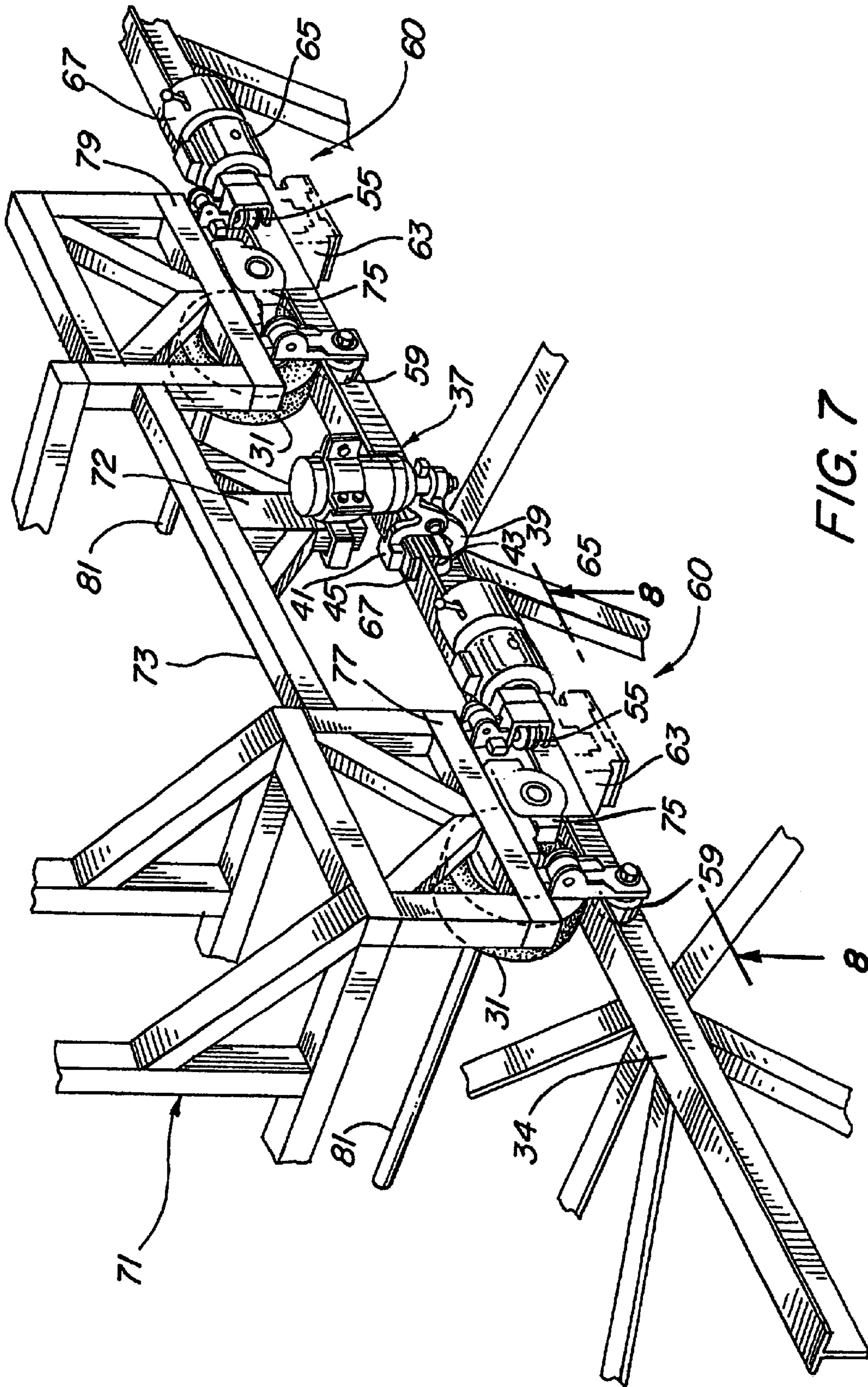
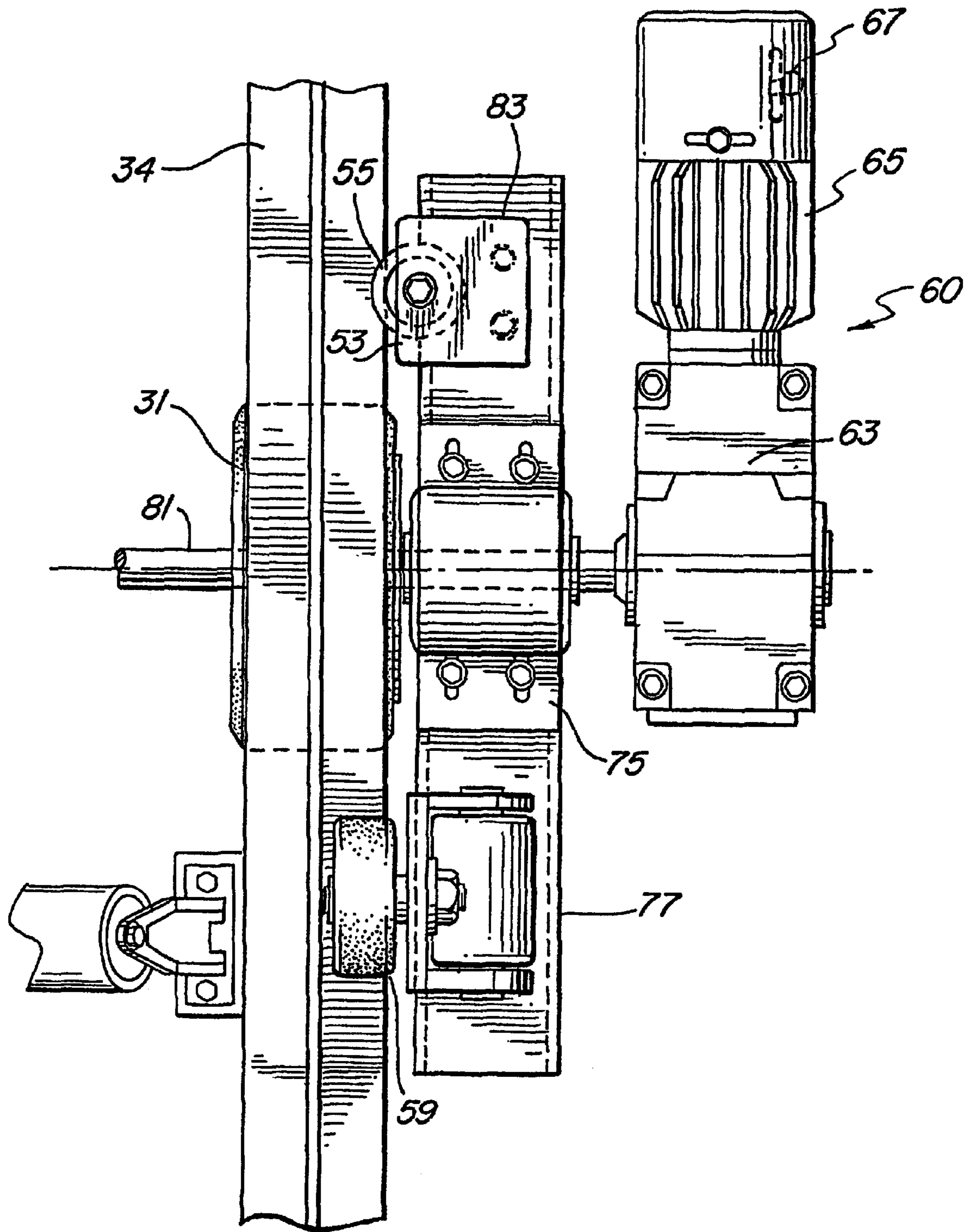


FIG. 7

FIG. 8



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TRACKING, PROPULSION AND BRAKING SYSTEM FOR BRIDGE TRIPPER/HOPPER CAR

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The subject matter relates generally to material moving apparatus and more particularly to improvements in belt trippers or hoppers which ride on a conveyor assembly.

2. Description of Related Art

A conventional belt tripper **11** is illustrated in FIG. 1. Such a belt tripper **11** typically travels up and down railroad tracks located on top of a long movable conveyor **13** as shown in FIG. 2. The tripper **11** functions to "trip" material off the long conveyor **13** to a short conveyor **15**, which builds a stack of material **14**. Apparatus known as "hoppers" are also similarly arranged to move up and down conveyors such as conveyor **13** to carry material along the conveyor. Trippers and hoppers of conventional design have exhibited numerous drawbacks.

First, conventional trippers/hoppers **11** ride on rail wheels **17**, as shown in FIG. 3. Typical rail wheels **17** have a flange **18** running on the inside of the rail **19**. These flanges **18** help guide and align the wheel **17** along the track, but are subject to derailment if the track is not even. This poses a serious safety concern: since it permits the tripper/hopper to derail, i.e., come off the top of the bridge **13**.

Current equipment designs further use a pad type brake **21**, FIG. 4, that applies pressure to the top of the rail **19**, using the weight of the tripper/hopper car. This design is similar to the braking system used on old trolley cars. The amount of friction developed is proportional to the weight of the machine and the spring tension.

Current equipment designs use dual wire ropes running the length of the bridge **13** that wrap around capstans on the tipper/hopper. Propulsion of the tripper/hopper is achieved by powering the capstans. Several problems exist with this system. With wire rope (cables), stretch is experienced as tension is applied through the capstans. The tripper/hopper's mass, plus the differential forces produced by the belt tensions, have to be overcome or resisted by the wire ropes. Overcoming the wire rope's stretch produces a jerky propulsion movement.

In addition, since the tensions on the wire rope can become different from side to side, the resulting forces can create racking and potentially can derail the tripper/hopper. The same difficulty could be experienced if one of the cables breaks. As stated above, only the flanges of the rail wheels keep the current design on the rails, and if it derails, the brakes are useless.

SUMMARY OF THE INVENTION

According to the invention, wheels are placed on three sides of a wheel runway at each of four drive points. On the top of each drive point there is a drive wheel. On the underside of the runway is a holddown wheel. In addition, side wheels are provided for wheel system for alignment. This mechanism makes it virtually impossible for a tripper/hopper to come off the top of the bridge.

According to another inventive aspect, a motor and motor brake are placed on each of the four drivewheels of the trip-

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per or hopper. The motor brake utilizes the reduction of a drive gearbox to increase the effective braking torque developed. Any one brake is designed to hold the machine.

The design is an "active" design, which provides increased safety factors and redundancy in the tracking system and the braking system. In addition, for added safety, a secondary "Fail Safe" brake system may be provided. The Fail Safe brake system incorporates two clamping type "rail" brakes to each tripper/hopper. Any time the propulsion system or power is turned off, the clamp brakes set and lock on the top chord of the bridge structure.

BRIEF DESCRIPTION OF THE DRAWINGS

The exact nature of this invention, as well as its objects and advantages, will become readily apparent upon reference to the following detailed description when considered in conjunction with the accompanying drawings, in which like reference numerals designate like parts throughout the figures thereof, and wherein:

FIG. 1 is a side view outlining a prior art belt tripper;

FIG. 2 is a perspective view illustrating an environment wherein a belt tripper may find use;

FIG. 3 is a fragmented cross sectional view illustrating a prior art belt tripper wheel mechanism;

FIG. 4 is a fragmented cross sectional view illustrating a prior art belt tripper brake mechanism;

FIG. 5 is a cross sectional view illustrating belt tripper tracking and braking apparatus useful according to the preferred embodiment; and

FIG. 6 is a perspective view illustrating a drive motor apparatus useful according to the preferred embodiment;

FIG. 7 is a perspective view illustrating presently preferred positioning and mounting of components illustrated in FIGS. 5 and 6; and

FIG. 8 is a top schematic view taken at 8-8 of FIG. 7.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Certain preferred features of the improved tracking, propulsion and braking systems are shown in FIG. 5. These features include a wheel tire **31** riding on one of two *wheel runways such as* structural T-section rails **34**, which typically comprise the top chord of a bridge truss, e.g., FIG. 1. The wheel tire **31** is relatively wide and of a larger diameter than the conventionally used rail wheels. Such tires assist in negotiating uneven surfaces and provide ease of mobility.

The wheel **31** is mounted on a rim structure **32**, which attaches to a plate **28** affixed to an axle **33**. The axle **33** is journaled in a vertical support **35** to which the belt tripper superstructure including its cab are attached.

A hydraulic brake assembly **37** is further shown welded or otherwise attached to the vertical support **35** by means of a channel **36**, which is angled 90 degrees, such that its hollow rectangular channel structure **38** is visible in FIG. 5. The brake **37** includes first and second calipers **39**, **41** mounting respective first and second brakes shoes **43**, **45**. The brake assembly **37** than acts like a disc brake and provides a "Fail Safe" feature as described herein.

On the outside of the T-section **34** are mounted a caster guide wheel **53** and a hold down roller wheel **59**. A piece of angled channel **47** extends around the wheel **31** and is welded or otherwise affixed to the support **35**. A suspending post **51** suspends a u-shaped caster mounting bracket **53** wherein the caster wheel **55** is rotatably mounted on a verti-

cally disposed shaft 54, such that wheel 55 rotates in a horizontal plane adjacent the vertical edge 56 of the T-section 34 and spaced apart therefrom.

Mounted beneath the bracket 53, either by attachment thereto or to post 51, is a strut 57 into which the roller wheel 59 is journaled. The roller wheel 59 is positioned immediately adjacent the underside edge of the structural T-member with a clearance of, for example, one-half inch. Such roller wheels 59 hold the belt tripper in position and preclude it from tipping off the track 34, while the caster guide wheel 55 further assists in holding the wheel tire 31 in place. With this construction it becomes highly improbable that the tripper will come off the bridge.

FIG. 6 illustrates the motor drive mount employed according to the preferred embodiment. As shown, an electric motor drive unit 60 is attached to drive each of the four wheel tires 31. The motor drive unit 31 includes a multi reduction, shaft-mounted gearbox 63, a motor 65 and an integral electric motor brake 67 with a Fail Safe, spring set electric release 69. The unit 60 is mounted to the wheel shaft 33 (FIG. 5) by means of a hollow shaft with shaft mount drive.

Thus, a motor brake 67 is provided on each of the four drive wheels 31. This brake utilizes the reduction of each drive gearbox 63 to increase the effective braking torque developed. Any one brake 67 is preferably designed to be sufficient to hold the machine. In order to increase the safety factor and redundancy of the braking system, each wheel drive incorporates an individual brake. For additional redundancy and safety, two hydraulic brakes 37 are provided. Any time the propulsion system or power are turned off, the Clamp Brake will set and lock onto the inside flange of the top chord of the bridge structure.

The electric motor drive units 60 preferably provide Variable Frequency Drives at all four wheels through a multi reduction gearbox to apply smooth, even propulsion to the tripper/hopper. Through use of state of the art electrical controls, the VFD's produce 100% torque throughout the frequency range of one to 50 hertz. The VFD allows the tripper/hopper to ramp up to travel speed smoothly and ramp down to a stop. The brakes then immediately set on each motor and the clamping brakes apply. The multiple output VFD controls and measures frequency and torque being applied to each drive motor. A main advantage of the motor drive system is that it provides a smooth propulsion system with the result that spills are minimized.

FIGS. 7 and 8 illustrate a presently preferred scheme for positioning the tracking, propulsion and braking components of FIG. 5 and 6 on a belt tripper structure 71. FIG. 7 illustrates one side of the belt tripper. The opposite side is similarly constructed.

As shown in FIG. 7, a brake assembly 37 is suspended from a horizontal structural member 73 by attachment to a vertical member 72. The brake assembly 37 is centrally positioned between first and second wheel tires 31, which are driven by respective motordrive units 60. These two motor-drive units 60 are each attached to the belt tripper structure 71 through use of respective pillow block bearings 75. The bearings 75 are attached to the underside of respective horizontal structural members 77, 79, via bolts, welding or other conventional attachment means.

As best seen in FIG. 8, each caster sidewheel 55 is positioned between the motordrive unit 60 and the structural T-section 34 of the bridge truss. Respective caster mounting brackets 53 are suspended from the respective horizontal members 77, 79 by respective arms 81 which are in turn

attached to an adapter bracket or transition bracket 83. The roller wheels 59 are similarly suspended from members 77, 79 and are each positioned spaced apart from and adjacent to a respective pillow block bearing 75.

Those skilled in the art will appreciate that various adaptations and modifications of the just-described preferred embodiment can be configured without departing from the scope and spirit of the invention. Therefore, it is to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

What is claimed is:

1. [The] An apparatus comprising:
 - a conveyer structure, including first and second T-sections; and
 - a car adapted to ride on said conveyor structure, said car comprising:
 - (a) two pairs of wheel tires positioned to ride on said first and second T-sections respectively, each wheel tire being driven by a respective motor drive unit, each drive unit including an electric motor, an electric motor brake and a [shaft-mounted] gearbox;
 - (b) four caster guide wheel each mounted adjacent a respective one of said wheel tires so as to rotate in a horizontal plane adjacent a vertical edge of one of said first and second T-sections; and
 - (c) four roller wheels, each mounted to rotate about an axis parallel to the axis about which said wheel tires rotate and immediately adjacent an underside edge of one of said first and second T-sections.
2. The apparatus of claim 1 further comprising:
 - first and second hydraulic caliper brakes each having respective brake shoes positioned to engage a respective one of said T-sections.
3. The apparatus of claim 1 wherein said car comprises a belt tripper.
4. The apparatus of claim 1 wherein said car comprises a hopper.
5. [The] An apparatus comprising:
 - a car adapted to ride on first and second [T-sections] *wheel runways* of a conveyer structure, said car comprising [two pairs of] *multiple* wheel tires positioned to ride on said first and second [T-sections respectively] *wheel runways*, each wheel tire being driven by a respective motor drive unit, each drive unit including an electric motor, an electric motor brake and a [shaft-mounted] gearbox.
6. The apparatus of claim 5 wherein said car further comprises:
 - four caster guide wheel each mounted adjacent a respective one of said wheel tires so as to rotate in a horizontal plane adjacent a vertical edge of one of said first and second [T-sections] *wheel runways*; and
 - four roller wheel, each mounted to rotate about an axis parallel to the axis about which said wheel tires rotate and immediately adjacent an underside edge of one of said first and second [T-sections] *wheel runways*.
7. The apparatus of claim 6 further comprising:
 - first and second hydraulic caliper brakes each having respective brake shoes positioned to engage a respective one of said [T-sections] *wheel runways*.
8. The apparatus of claim 5 wherein said car comprises a belt tripper.
9. The apparatus of claim 5 wherein said car comprises a hopper.

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10. An apparatus comprising:
 a conveyer structure, including first and second T-sections; and
 a car adapted to ride on said conveyer structure, said car comprising:
- (a) two pairs of wheel tires positioned to ride on said first and second T-sections respectively, each wheel tire being driven by a respective motor drive unit, each drive unit including an electric motor, an electric motor brake and a gearbox;
- (b) four caster guide wheels each mounted adjacent a respective one of said wheel tires so as to rotate in a horizontal plane adjacent a vertical edge of one of said first and second T-sections; and
- (c) four roller wheels, each mounted to rotate about an axis parallel to the axis about which said wheel tires rotate and immediately adjacent an underside edge of one of said first and second T-sections.
11. The apparatus of claim 10 further comprising:
 first and second hydraulic caliper brakes each having respective brake shoes positioned to engage a respective one of said T-sections.
12. The apparatus of claim 10 wherein said car comprises a belt tripper.
13. The apparatus of claim 10 wherein said car comprises a hopper.
14. An apparatus comprising:
 a car adapted to ride on first and second wheel runways of a conveyer structure, said car comprising multiple wheel tires positioned to ride on said first and second wheel runways, each wheel tire being driven by a respective motor drive unit, each drive unit including an electric motor, an electric motor brake and a gearbox, the car having caliper brakes with brake shoes positioned to engage a wheel runway.
15. The apparatus of claim 14 wherein said car comprises a belt tripper.
16. The apparatus of claim 14 wherein said car comprises a hopper.
17. An apparatus comprising:
 a car adapted to ride on first and second wheel runways of a conveyer structure, said car comprising: multiple wheel tires positioned to ride on said first and second wheel runways, each wheel tire being driven by a respective motor drive unit, each driver unit including an electric motor, an electric motor brake and a gearbox;
- caster guide wheels mounted adjacent a plurality of said wheel tires so as to rotate in a horizontal plane adjacent a vertical edge of one of said first and second wheel runways; and
- four roller wheels, mounted to rotate about an axis parallel to the axis about which said wheel tires rotate and immediately adjacent an underside edge of one of said first and second wheel runways.

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18. The apparatus of claim 17 further comprising:
 first and second hydraulic caliper brakes each having respective brake shoes positioned to engage a respective one of said wheel runways.
19. An apparatus comprising:
 a conveyer structure for moving material having first and second wheel runways; and
 a car adapted to travel on the material conveyer structure, the car comprising multiple wheel tires positioned to ride on the first and second wheel runways, certain of the wheel tires being driven by a motor drive unit, each motor drive unit including a motor with a motor brake, and a gear box connecting the motor to the wheel tire being driven and roller wheels mounted to rotate about an axis parallel to the axis about which the wheel tire rotates, adjacent an underside of one of the first and second wheel runways.
20. The apparatus of claim 19 wherein the gear box is a reduction gearbox.
21. The apparatus of claim 19 wherein the car further comprises:
 caster guide wheels mounted adjacent a wheel tire so as to rotate in a horizontal plane adjacent a vertical edge of one of the first and second wheel runways.
22. The apparatus of claim 19 wherein the motor of the motor drive unit is an electric motor and the motor brake is an electric motor brake.
23. The apparatus of claim 22 wherein the gear box is a reduction gearbox.
24. The apparatus of claim 23 wherein the car further comprises:
 caster guide wheels mounted adjacent a wheel tire so as to rotate in a horizontal plane adjacent a vertical edge of one of the first and second wheel runways.
25. An apparatus comprising:
 a conveyer structure for moving material having first and second wheel runways; and
 a car adapted to travel on the conveyer structure, the car comprising multiple wheel tire positions to ride on the first and second wheel runways, certain of the wheel tires being drawn by a motor drive unit, each motor drive unit including a motor with a motor brake, and a gear box connecting the motor to the wheel tire being driven, the car having caliper brakes with brake shoes positioned to engage a wheel runway.
26. The apparatus of claim 25 wherein the car further comprises:
 roller wheels mounted to rotate about an axis parallel to the axis about which the wheel tires rotate, adjacent an underside of one of the first and second wheel runways.

* * * * *