Jan. 16, 1962 A. L. LADO 3,016,636

ROAD SCRAPER WITH DRIVEN LEANING WHEELS

Filed March 30, 1956 8 Sheets-Sheet 1

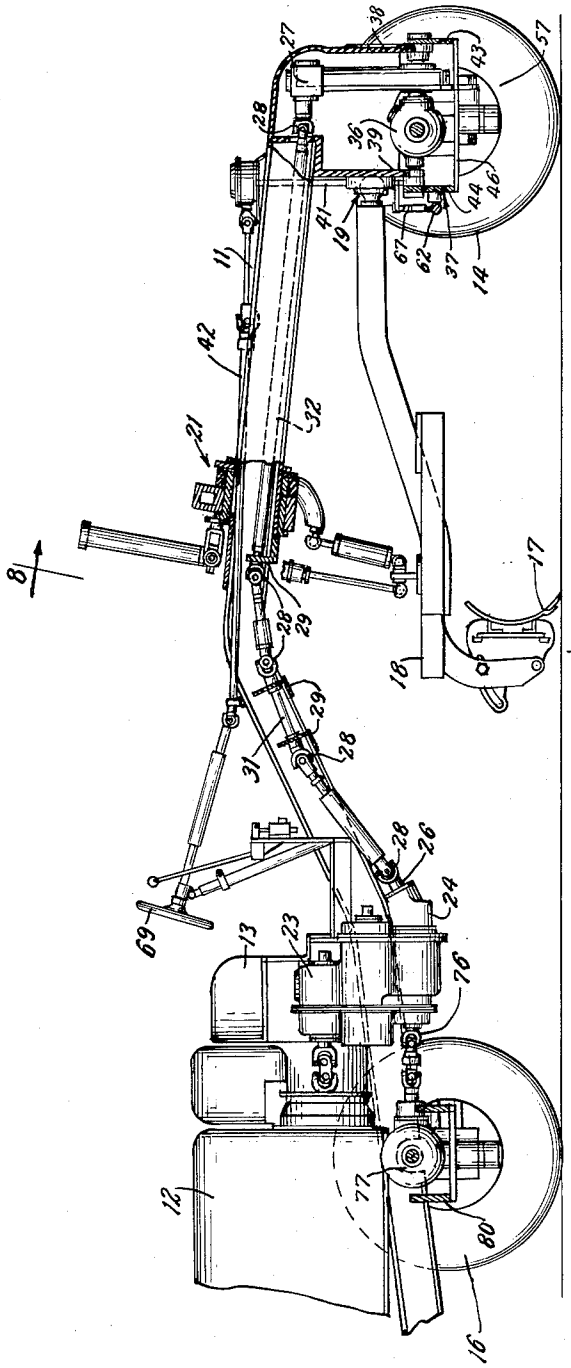


Fig-1

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ROAD SCRAPER WITH DRIVEN LEANING WHEELS

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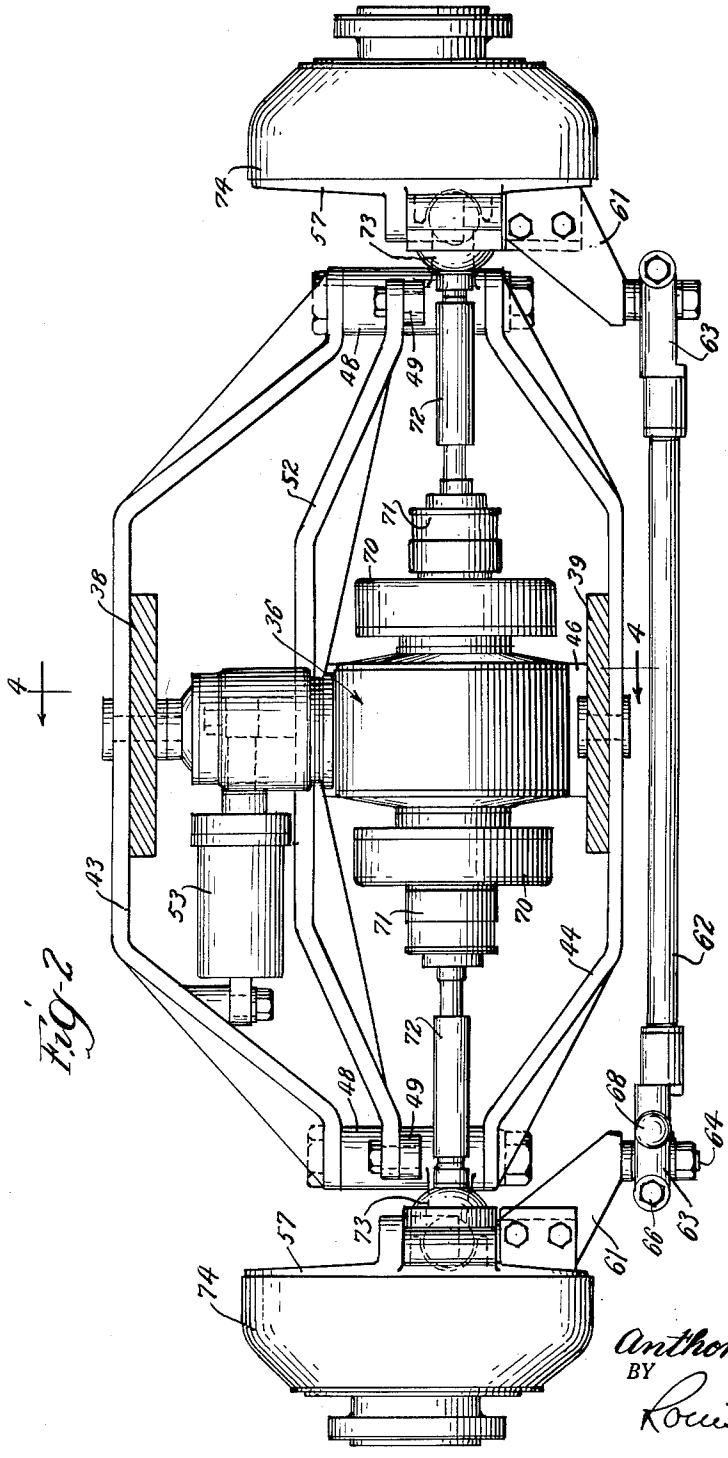


Fig. 2

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ROAD SCRAPER WITH DRIVEN LEANING WHEELS

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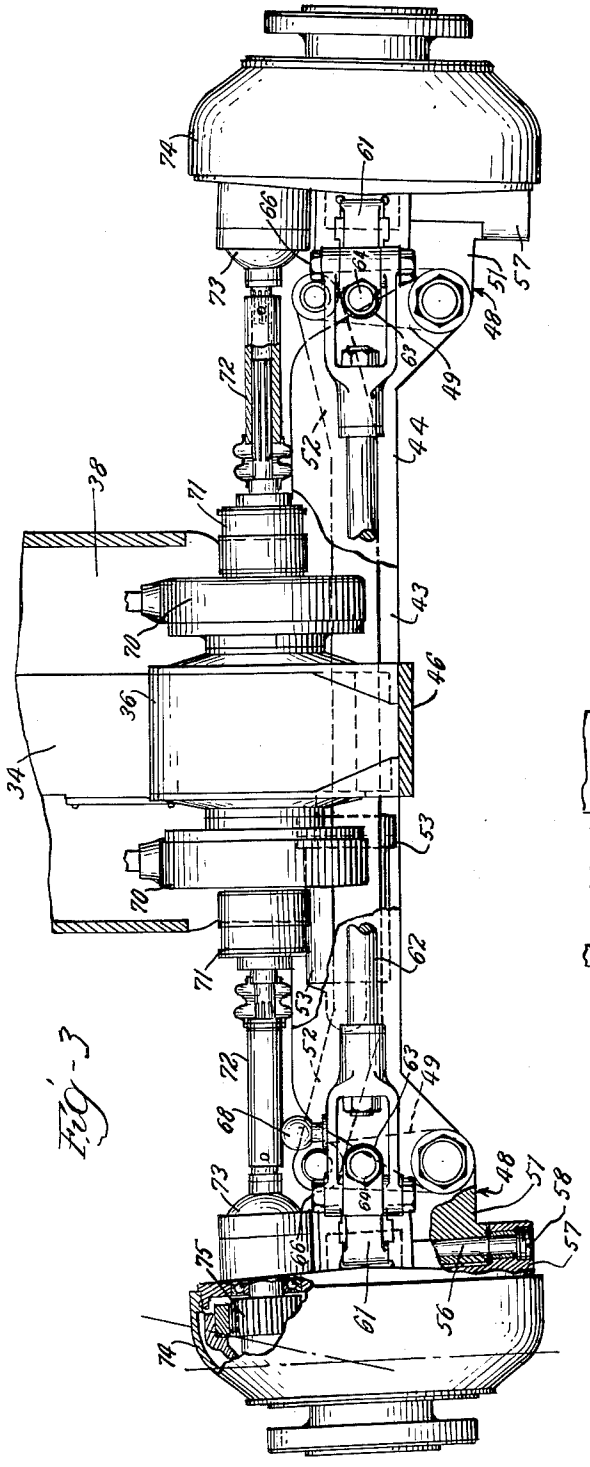


Fig. 3

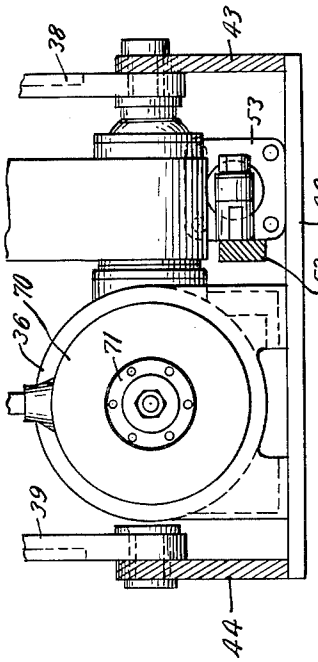


Fig. 4

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ROAD SCRAPER WITH DRIVEN LEANING WHEELS

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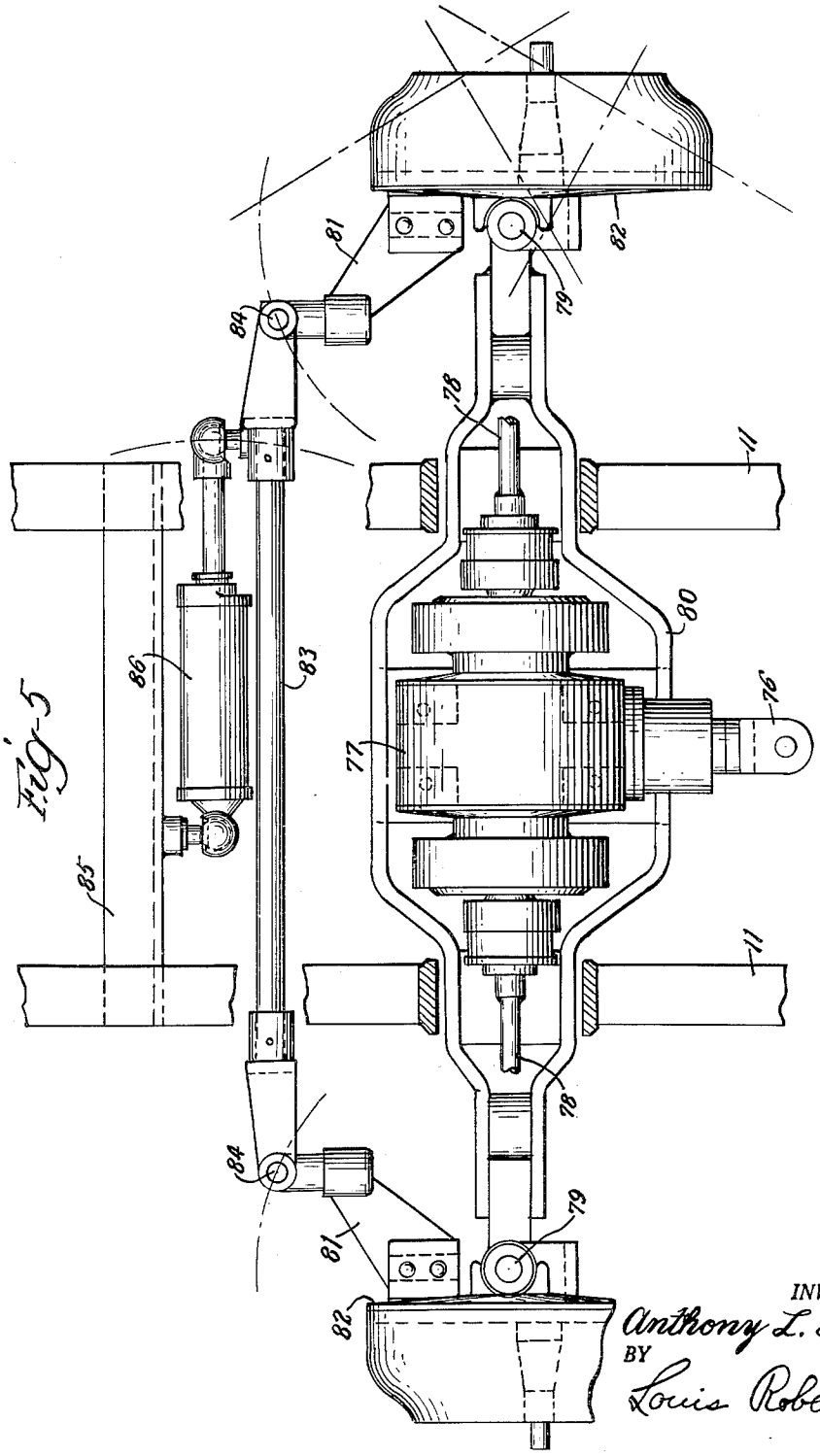


Fig-5

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ROAD SCRAPER WITH DRIVEN LEANING WHEELS

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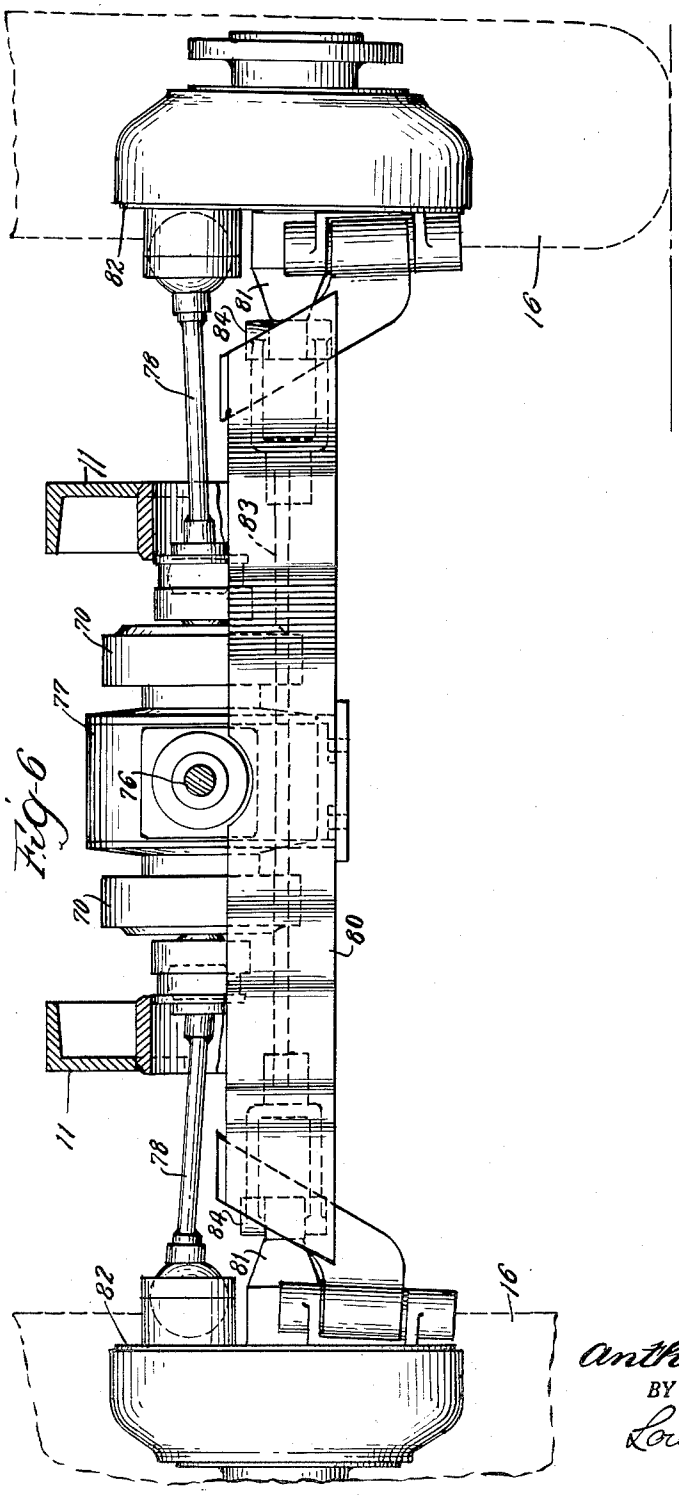


Fig-6

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ROAD SCRAPER WITH DRIVEN LEANING WHEELS

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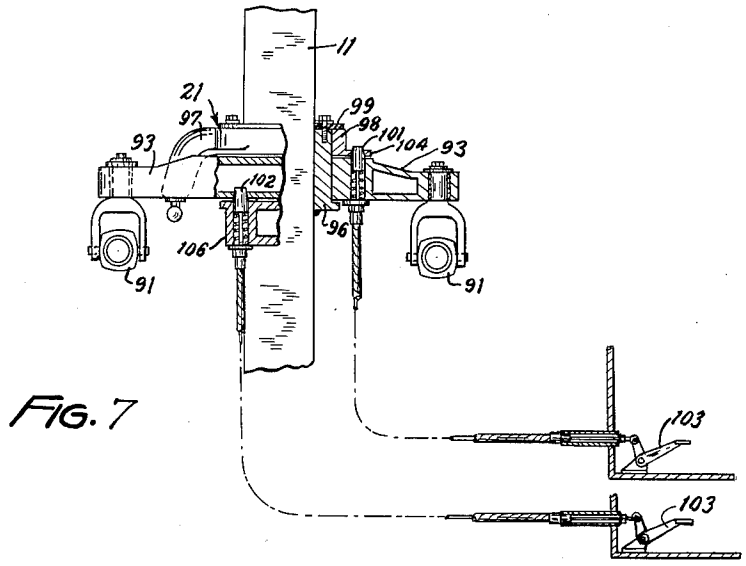


FIG. 7

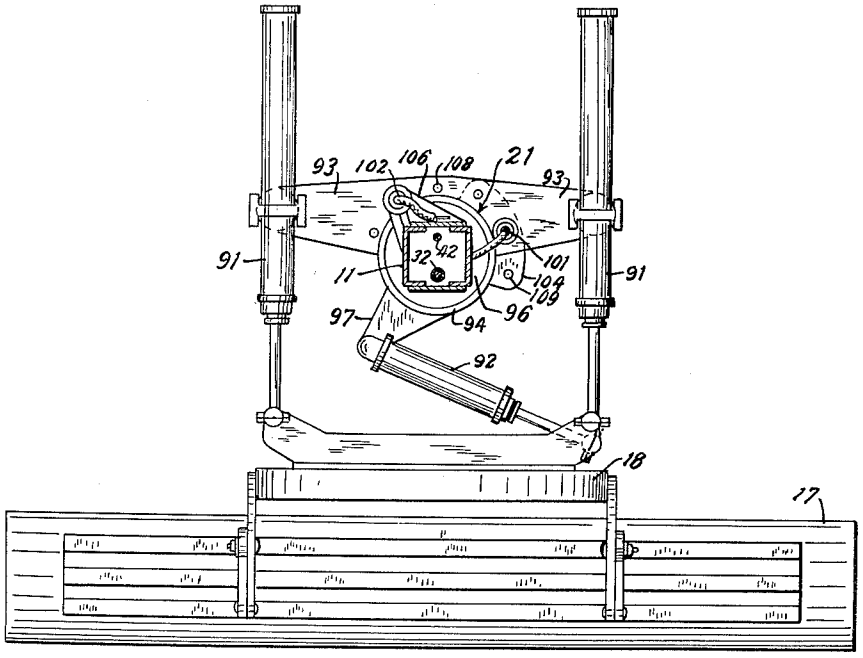


FIG. 8

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ROAD SCRAPER WITH DRIVEN LEANING WHEELS

Filed March 30, 1956 8 Sheets-Sheet 7

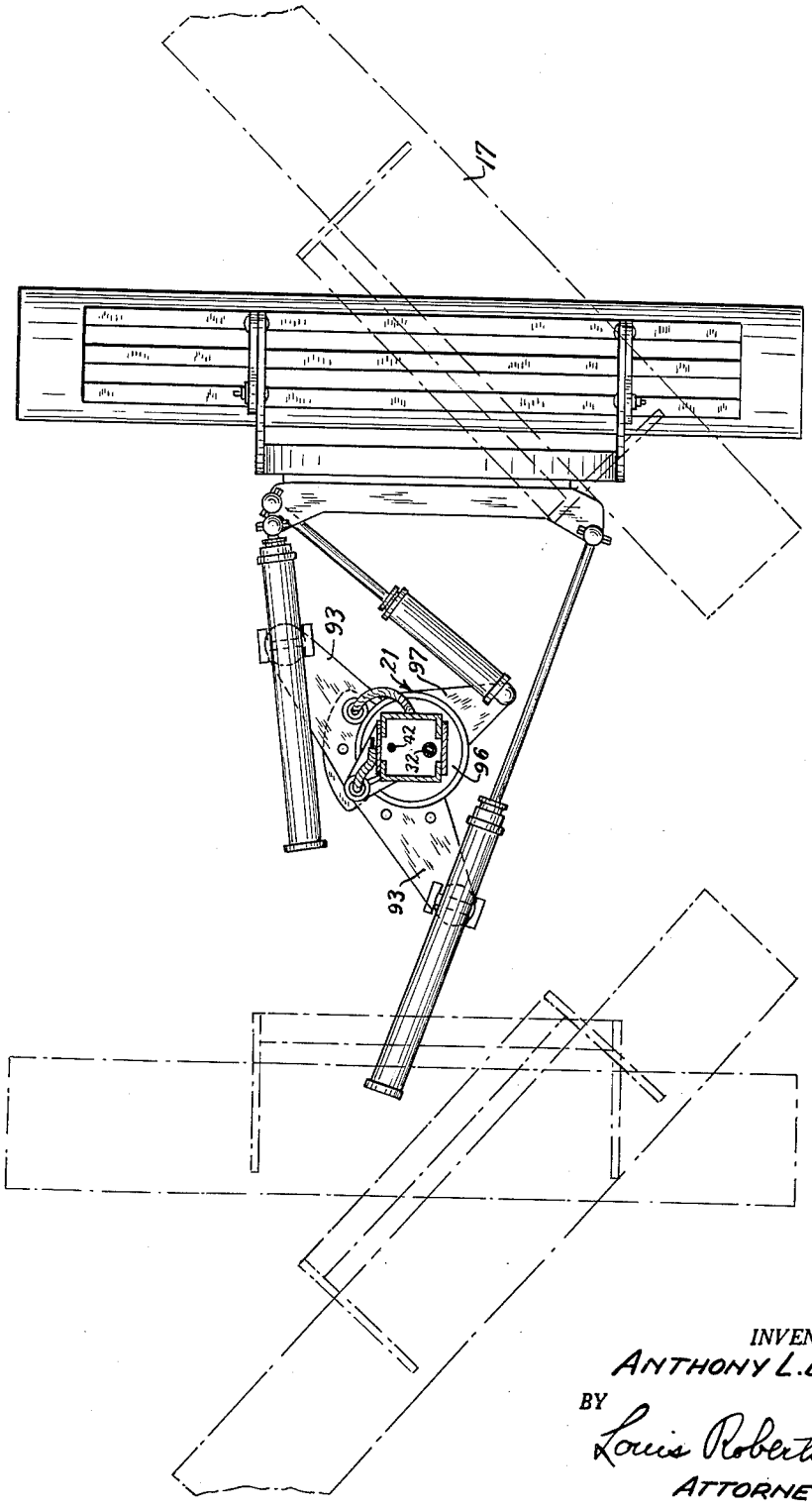


FIG. 9

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ROAD SCRAPER WITH DRIVEN LEANING WHEELS

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FIG. 11

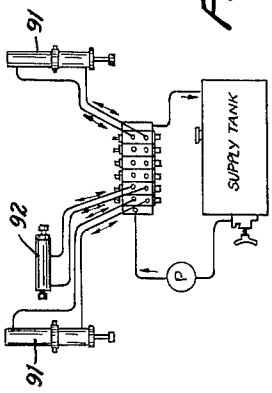


FIG. 10

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United States Patent Office

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Patented Jan. 16, 1962

3,016,636

ROAD SCRAPER WITH DRIVEN LEANING WHEELS

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Filed Mar. 30, 1956, Ser. No. 575,234
9 Claims. (Cl. 37—156)

The advantages of leaning wheels for road scrapers have long been known. According to the present invention, a self-propelled road scraper is provided in which the forward wheels are not only leaning and steerable but also driven. The rear wheels are also driven and steerable, thus providing four-wheel drive and four-wheel steering. The drive for the front wheels is carried through the arch frame and thus does not interfere with the provision of a rotatable collar mounted around this frame, from which the blade can be suspended, so that the blade can be swung to either side for cutting banks.

Additional objects and advantages will be apparent from the accompanying description and from the drawings.

DESIGNATION OF FIGURES

FIG. 1 is a somewhat diagrammatic view in the nature of a longitudinal sectional view, showing the extension of the drive through the arch yoke and the general relationship of parts.

FIGS. 2, 3 and 4 are views of the front axle assembly, FIG. 2 looking down on such assembly, FIG. 3 looking forwardly toward such assembly, and FIG. 4 being a vertical section somewhat irregularly taken in the general vicinity of line 4—4 of FIG. 2.

FIGS. 5 and 6 are views of the rear axle assembly, FIG. 5 looking down on the axle and FIG. 6 looking rearwardly toward the axle.

FIGS. 7 to 11 are views of the blade-mounting and swinging mechanism, FIGS. 8 to 10, respectively, showing the blade centered, to the right, and to the left. FIG. 7 shows the lock mechanism and FIG. 11 shows the hydraulic controls for the operating cylinders.

Although the law requires a full and exact description of at least one form of the invention, such as that which follows, it is, of course, one purpose of a patent to cover each new inventive concept therein no matter how it may later be disguised by variations in form or additions of further improvements; and the appended claims are intended to accomplish this purpose by particularly pointing out the parts, improvements, or combinations in which the inventive concepts are found.

GENERAL DESCRIPTION

The illustrated form of the invention is built on and around a main frame 11, commonly called an arch frame because the forward portion thereof is shaped in the form of an arch, as seen in FIG. 1. An engine 12 is mounted at the rear portion of the arch frame 11. A driver's seat 13 is located in front of the engine 12. A pair of front wheels 14 are mounted on an axle assembly by which the front of the arch frame 11 is carried, and a pair of rear wheels 16 is mounted on a rear axle assembly, by which the rear end of the arch frame 11 is carried. The scraper blade 17 is carried on the under side of a sub-frame 18, which is drawn forwardly by a universally pivotal connection 19 and is controlled in its position by a swing control assembly 21, which extends around and is carried by an intermediate portion of the arch frame 11.

In the preferred form of the invention, all four wheels 14 and 16 are driven by the engine 12, all four are steerable, and at least the front wheels 14 are leanable for most satisfactory resistance of the side drag of a sloping

blade. The subframe 18 usually includes a "circle" and drive device by which the blade can be shifted about a vertical axis to any angle.

FRONT-WHEEL DRIVE

The engine 12 is coupled to a transmission 23 which may be a conventional variable speed and reverse heavy-duty vehicle transmission. There is preferably added to the conventional portion of the transmission a bevel-gear output unit 24 provided with an output shaft 26 approximately on the axis illustrated in FIG. 1. Through a series of universally-coupled drive shafts, the output shaft 26 is coupled to the input shaft of a chain-drive unit 27 at the front end of the arch frame 11. Generally speaking, this series of drive shafts follows the arch contour of the arch frame 11. Between each of the units of the series of drive shafts, and at each end of the series, a universal joint 28 is provided. Fixed bearing supports 29 are provided where needed. Thus the second drive-shaft unit 31 is provided with two fixed bearing supports, and the final drive-shaft unit 32 has a fixed bearing support at its rear end, the front end thereof being positioned by the front universal joint 28. Each of the fixed bearing units 29 preferably includes a ball-bearing unit. In the illustrated form of the invention, all of the drive shafts of the series, except the shaft 31, are telescoping, thus ensuring that there will be no binding on the universal joint. The universal joints are of the top quality needle-bearing type. The illustrated arrangement provides an angularity for each universal joint within the permissible heavy-duty ranges for these joints.

The chain-drive unit 27 is preferably of the multichain type. It is coupled to differential gear unit 36. The casing of the differential unit 36 is mounted rigidly in the front axle assembly 37 and has a sealed but swivelled connected with the casing of chain-drive unit 27. Chain-drive unit 27 is rigidly carried by the front downward extension of the arch frame 11.

The arch frame 11 is provided with downwardly-extending walls 38 and 39, by which the front end of the vehicle is supported on the axle assembly. The wall 39 also carries the socket portion of the ball-and-socket connection 19, by which the scraper blade is dragged. In addition, it supports a bearing for the lower end of steering connection 41. It may be noted that, for convenience of illustration, the steering connection is shown in FIG. 1 as if it were positioned at the left of arch frame 11, whereas in fact it is at the right.

The part of the steering mechanism illustrated in FIG. 1 is largely conventional. Mention should be made, however, that the steering shaft 42, where it passes through the swing mounting assembly 21 for the blade, is shown within the outlines of the arch frame 11, as is the drive shaft 32.

FRONT AXLE ASSEMBLY

The front axle assembly is best seen in FIGS. 2 to 4. The arch frame, represented by the wall members 38 and 39, is supported by a rigid axle beam comprising transverse plates 43 and 44, welded to a bottom plate 46. Plate 43 is pivotally connected to wall 38 and plate 44 is pivotally connected to wall 39. The differential unit 36 is rigidly mounted on plate 46.

The plates 43 and 44 have down-turned ends between which are mounted knuckles 48, one for the left wheel and one for the right wheel. Each knuckle 48 is in the form of a bell crank lever with a generally vertical arm 49 and a generally horizontal arm 51. The vertical arm 49 of the bell crank levers are connected together by a cross link 52 controlled by a hydraulic cylinder 53, carried by plate 43. The cylinder 53 can move the cross link 52 in either direction from the centered position

shown to rock the bell crank knuckles 48 for leaning the wheels in either direction. Link 52 is pivotably connected to each of the arms 49.

As will be recognized from the drawings, the cylinder 53 may be pivotally carried by plate 43 and has a piston operating within it which is connected by a piston rod and a pivotal connection to cross link 52. The cylinder 53 is a double-acting cylinder, having hydraulic connections at opposite ends, which may be omitted from the illustrations for simplicity.

The outwardly-extending arm 51 of each bell crank knuckle 48 has a hinged connection with the wheel for steering. As seen at the left in FIG. 3, this hinged connection may include a tapered pin 56 on which the arm 51 will seat, and which will therefore function as a part of the arm 51. The upper and lower ends of pin 56, projecting beyond arm 51 are cylindrical and form bearing surfaces for steering, only the one below the arm 51 being shown. In each instance, the cylindrical portion of the pin is surrounded by a bearing sleeve carried in an extension from the inner hub casting 57, by which the wheel is rotatably carried in a well-known manner. A plug 58 is threaded into hub casting 57 below pin 56 to adjust the height of the pin 56 within its bearings. A thrust disk bearing is interposed between the pin 56 and the plug 58.

Steering arm 61 is rigidly secured to each inner hub casting 57. The two steering arms 61 are connected together by a tie rod 62, the connection of the tie rod 62 to each arm 61 being through a universal joint 63. When the wheel is leaned by rocking knuckle 48, pivotal action occurs between the adjacent steering arm 61 and tie rod 62 about the axis of the stub shaft 64. As the wheel is turned about the pin 56 for steering, pivoting between the arm 61 and tie rod 62 occurs about the axis of bolt 66. Steering is accomplished by steering link 67 (indicated only diagrammatically in FIG. 1), which engages a steering ball 68 upstanding from one of the universal joints 63.

From the foregoing, it is apparent that the front wheels 14 may be turned for steering by a steering wheel 69 at the driver's position. Of course, power steering may be provided, if desired. Also, the front wheels 14 may be leaned in either direction by control from the driver's position merely by operating a valve, not shown, to apply hydraulic pressure to either end of the cylinder 53. This valve also has a lock position, in which the valve is closed with respect to both ends of the cylinder 53, so that the wheels are firmly held at any angle of tilt.

The drive between the differential 36 and the wheels is best indicated in FIGS. 2 and 3. The output shafts of the differential assembly (a term which may be used as including any added devices, such as brakes 70) are connected through universal joints 71 to telescopic shafts 72, which in turn are connected through universal joints 73 to the drive pinions for the wheels. It will be understood that the wheels may be a conventional pinion drive type, in which the drive pinions 75 rotate about axes near the top of the inner hub 57 and engage ring gears on the inside of the rotating hub structure 74, the rotating hub structure rotating on a pintle extending outwardly from and rigid with the inner hub casting 57. The telescopic action of the telescopic shaft 72 must be relatively long, in order to accommodate the change of length required when the wheels are leaned.

It will be observed that the advantages of high clearance, which has long been recognized as a desirable characteristic of the pinion type of wheel drive is here retained in spite of the fact that the wheels can be both leaned and steered.

REAR DRIVE

As seen in FIG. 1, the transmission unit 23 is also provided with a rear output shaft 76. This shaft is coupled to a differential unit 77. In the illustrated form, the coupling is through universal joint and an intermediate drive shaft. As seen best in FIG. 6, the rear wheels 16 are driven from the differential unit 77 in a manner quite similar to that already described for the front wheels. However, in the illustrated form, these wheels cannot be leaned, and therefore the drive shafts 78 need have little or no telescoping capacity. The lack of the leaning feature also permits some simplification of the rear axle assembly, as illustrated, 80 being the axle frame structure. In the illustrated form, however, steering is permitted, the wheels being hinged on pins 79. Steering arms 81 are rigidly secured to the inner hub plates 82 and are connected together by a tie rod 83 through pivots 84. The tie rod 83 may be operated in either direction or locked in a set position by double-acting hydraulic cylinder 86, swivelled to cross member 85 of the frame and controlled by a valve at the driver's position, the valve having a lock position. It is contemplated that the rear wheels will not be steered during the ordinary moment-to-moment steering, but will be set for a given operation and locked in the said position. Of course, they may be changed for momentary steering on the relatively rare occasions when this is required.

During heavy scraping with a diagonal blade, the front wheels will be leaned to resist the side drag on the blade. If the rear wheels tend to work sidewise also, cylinder 86 may be operated to set them at a slight angle to overcome this side pull. For turning around with a minimum turning radius or for maneuvering the rear end past an obstruction or around a corner, the cylinder 86 may be operated to swing the rear wheels as far as they will go.

SWING MOUNTING FOR BLADE

As seen best in FIG. 8, the subframe 18 by which the blade 17 is carried is raised or lowered or tilted by hydraulic cylinders 91, which are often called the lift cylinders. The frame 18 may be moved to either side by a third cylinder 92, often called a side thrust cylinder. Each of the cylinders is double acting and is controlled by a valve with a lock position for hydraulically locking the controlled device in a given position, and preferably also a float position. With the valve in the float position, the liquid may run freely from one end of the cylinder to the other, so that the piston moves easily within the cylinder in response to externally-applied forces applied to its piston rod.

All three cylinders are pivotally connected to their supports and to the subframe 18. The three cylinders are preferably carried by arms which can be swung about the arch frame 11 to provide a wider range of movement of the subframe 18. This wide range of movement is not new but the specific construction by which it is accomplished is new, and its provision with four-wheel drive is new. Its use in conjunction with four-wheel drive is made possible by positioning the drive shaft 32 within the arch frame 11, so that it does not interfere with movement of the cylinders 91 and 92 and their supporting arms about the arch frame 11.

In the illustrated form of swing mounting, the two lift cylinders 91 are carried by arms 93 which comprise opposite ends of the same member. The arms 93 are provided with a yoke portion 94 which cooperates to form an annular bearing resting on a collar 96, which may be welded to the arch frame 11. The arm 97 by which the cylinder 92 is carried also includes a yoke portion 98 which cooperates to form an annular bearing resting on the collar 96. The arms, which may be taken as including the yoke portions thereof, are retained on the collar 96 by being restrained in one direction by a flange formed on the collar and in the other direction by a ring 99 secured to the collar. Except when locked by lock bolts 101 and 102, the arms 93 and 97 are free to rotate or swing on the collar 96.

The lock bolts 101 and 102 are controlled from the driver's position, as by foot pedals 103. The lock bolts

101 and 102 may be spring-actuated to the closed position. Lock bolt 101 is carried by the arm 93 and locks into a flange 104 carried by arm 97. Lock bolt 103 is carried by a fixed arm 106 which may be welded to arch frame 11.

One example of the series of operations by which the blade 17 may be swung from the position of FIG. 8 to the position of FIG. 9 is as follows:

The valve for cylinder 92 is controlled to thrust the blade 17 to the right as far as it will go, and the valve for the lift cylinders 91 are controlled to set the blade 17 down on the ground. Then the valve for cylinder 92 is set in the float position, the latch pin 102 is withdrawn by its associated foot pedal 103 and the valve for cylinders 91 are operated to swing the arms 93 counterclockwise until the right-hand aperture 108 is aligned with lock bolt 102. During this swinging motion, the foot pedal 103 will have been released so that when alignment occurs, lock bolt 102 will snap into aperture 108 and lock arms 93. Now lock bolt 101 is withdrawn by its associated foot pedal 103, and the valve for cylinder 92 is operated to swing arm 97 counterclockwise. Foot pedal 103 is released, and when right-hand aperture 109 of flange 104 reaches alignment with lock bolt 101, the latter snaps into aperture 109 and locks arm 97. The arms 93 and 97 will now be in the position shown in FIG. 9, thereby permitting the blade 17 to be swung to the vertical right-hand position as seen in full lines in FIG. 9. In similar manner, the arms 93 and 97 may be swung to the position shown in FIG. 10, after which the blade 17 may be swung to the position shown in full lines in FIG. 10.

FIG. 11 represents a typical hydraulic system for control of the cylinders 91 and 92, as well as including other valves for controlling units not represented in this figure.

If desired, the drive shaft 32 and steering shaft 42 could pass through collar 96 between the cylindrical bearing surface thereof and the frame 11.

I claim:

1. A road scraper including a frame forming an arch, a scraper blade supported by the frame beneath the raised portions of the arch; front and rear axle assemblies under the end portions of the frame and supporting the frame; an engine on one end portion of the frame; driving connections between the engine and the adjacent axle assembly; driving connections between the engine and the remote axle assembly, including a series of drive shafts connected by universal joints; a mounting and swinging assembly surrounding the frame and with it one of said drive shafts near the top of the arch and rotatable on said frame; chain drive means extending downwardly from the final one of the series of drive shafts to the remote axle assembly for driving the latter; each axle assembly including an axle beam, wheels carrying the beam and rotatable thereon at opposite ends thereof, a differential gear unit carried on the beam with output shafts approximately in alignment with the upper edges of the wheel hubs, and drive shaft and universal joint means connecting the differential output shafts in driving relation to the wheels; all four wheels being steerable, and the wheels on one axle assembly being leanable with respect to the axle assembly, the drive shafts on this axle assembly being telescopic to accommodate the leaning movement of said wheels.

2. A road scraper including a frame forming an arch, a scraper blade supported by the frame beneath the raised portions of the arch; front and rear axle assemblies under the end portions of the frame and supporting the frame; an engine on one end portion of the frame; driving connections between the engine and the adjacent axle assembly; driving connections between the engine and the remote axle assembly, including a series of drive shafts connected by universal joints; chain drive means extending downwardly from the final one of the series of drive shafts to the remote axle assembly for driving the latter; each axle assembly including an axle beam, wheels carrying the beam and rotatable thereon at opposite ends thereof, a differential gear unit carried on the beam with output shafts approximately in alignment with the upper edges of the wheel hubs, and drive shaft and universal joint means connecting the differential output shafts in driving relation to the wheels; all four wheels being steerable, and the wheels on one axle assembly being leanable with respect to the axle assembly, the drive shafts on this axle asembly being telescopic to accommodate the leaning movement of said wheels.

3. A road scraper including a frame forming an arch, a scraper blade supported by the frame beneath the raised portions of the arch; front and rear axle assemblies under the end portions of the frame and supporting the frame; an engine on one end portion of the frame, driving connections between the engine and the adjacent axle assembly; driving connections between the engine and the remote axle assembly, including a series of drive shafts connected by universal joints; a mounting and swinging assembly surrounding the frame and with it one of said drive shafts near the top of the arch and rotatable on said frame; chain drive means extending downwardly from the final one of the series of drive shafts to the remote axle assembly for driving the latter.

4. A road scraper including a frame, a scraper blade supported by the frame; front and rear axle assemblies under the end portions of the frame and supporting the frame; an engine on one end portion of the frame, driving connections between the engine and the adjacent axle assembly; driving connections between the engine and the remote axle assembly; each axle assembly including an axle beam, wheels carrying the beam and rotatable thereon at opposite ends thereof, a differential gear-unit carried on the beam with output shafts approximately in alignment with the upper edges of the wheel hubs and drive shaft and universal joint means connecting the differential output shaft in driving relation to the wheels; all four wheels being steerable, and the wheels on one axle assembly being leanable with respect to the axle assembly, the drive shafts on this axle assembly being telescopic to accommodate the leaning movement of said wheels.

5. A road scraper including a frame, a scraper blade supported by the frame; front and rear axle assemblies under the end portions of the frame and supporting the frame; an engine on one end portion of the frame, driving connections between the engine and the adjacent axle assembly; driving connections between the engine and the remote axle assembly; each axle assembly including wheels rotatable at opposite ends thereof, a differential gear-unit and drive shaft means connecting the differential in driving relation to the wheels; all four wheels being steerable, and the wheels on one axle assembly being leanable with respect to the axle assembly, the drive shafts on this axle assembly being telescopic to accommodate the leaning movement of said wheels.

6. A road scraper including a frame, a scraper blade supported by the frame, front and rear axle assemblies under the end portions of the frame and supporting the frame; an engine on the frame, driving connections between the engine and an axle assembly; said axle assembly including an axle beam, wheels carrying the beam and rotatable thereon at opposite ends thereof, a differential gear unit carried on the beam with output shafts approximately in alignment with the upper edges of the wheel hubs, and drive shaft and universal joint means connecting the differential output shafts in driving relation to the wheels, said wheels being steerable and leanable with respect to said beam, and said drive shafts being telescopic to accommodate the leaning movement of said wheels.

7. An axle assembly, including an axle beam, wheels carrying the beam and rotatable thereon at opposite ends thereof, a differential gear unit carried on the beam with

output shafts approximately in alignment with the upper edges of the wheel hubs, and drive shaft and universal joint means connecting the differential output shafts in driving relation to the wheels, said wheels being steerable and leanable with respect to said beam, and said drive shafts being telescopic to accommodate the leaning movement of said wheels.

8. An axle assembly, including an axle beam, wheels carrying the beam and rotatable thereon at opposite ends thereof, a differential gear unit carried on the beam with output shafts approximately in alignment with the upper edges of the wheel hubs, and drive shaft and universal joint means connecting the differential output shafts in driving relation to the wheels, said wheels being mounted on said beam for pivoting about a generally vertical axis and a generally horizontal axis so as to be steerable and leanable with respect to said beam, and said drive shafts being telescopic to accommodate the leaning movement of said wheels.

9. An axle assembly, including an axle beam, wheels carrying the beam and rotatable thereon at opposite ends thereof, a differential gear unit carried on the beam with output shafts approximately in alignment with the upper edges of the wheel hubs, and drive shaft and universal joint means connecting the differential output shafts in driving relation to the wheels, said wheels being mounted on said beam for pivoting about a generally vertical axis and a generally horizontal axis so as to be steerable and leanable with respect to said beam, and said drive shafts being telescopic to accommodate the leaning movement of said wheels; power means for leaning said wheels and means for steering said wheels.

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