No. 624,003. Patented May 2, 1899.

J. EVANS & R. W. HEALEY.

WHEEL CENTER.

(Application filed Mar. 23, 1898.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 3.

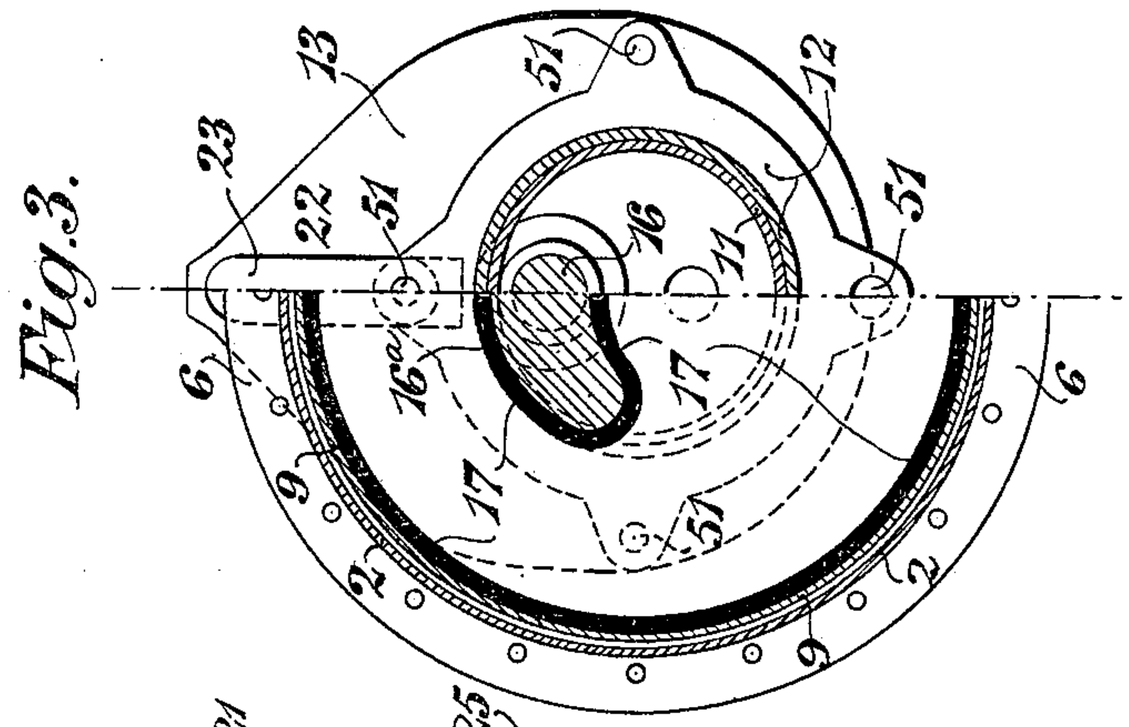


Fig. 1.

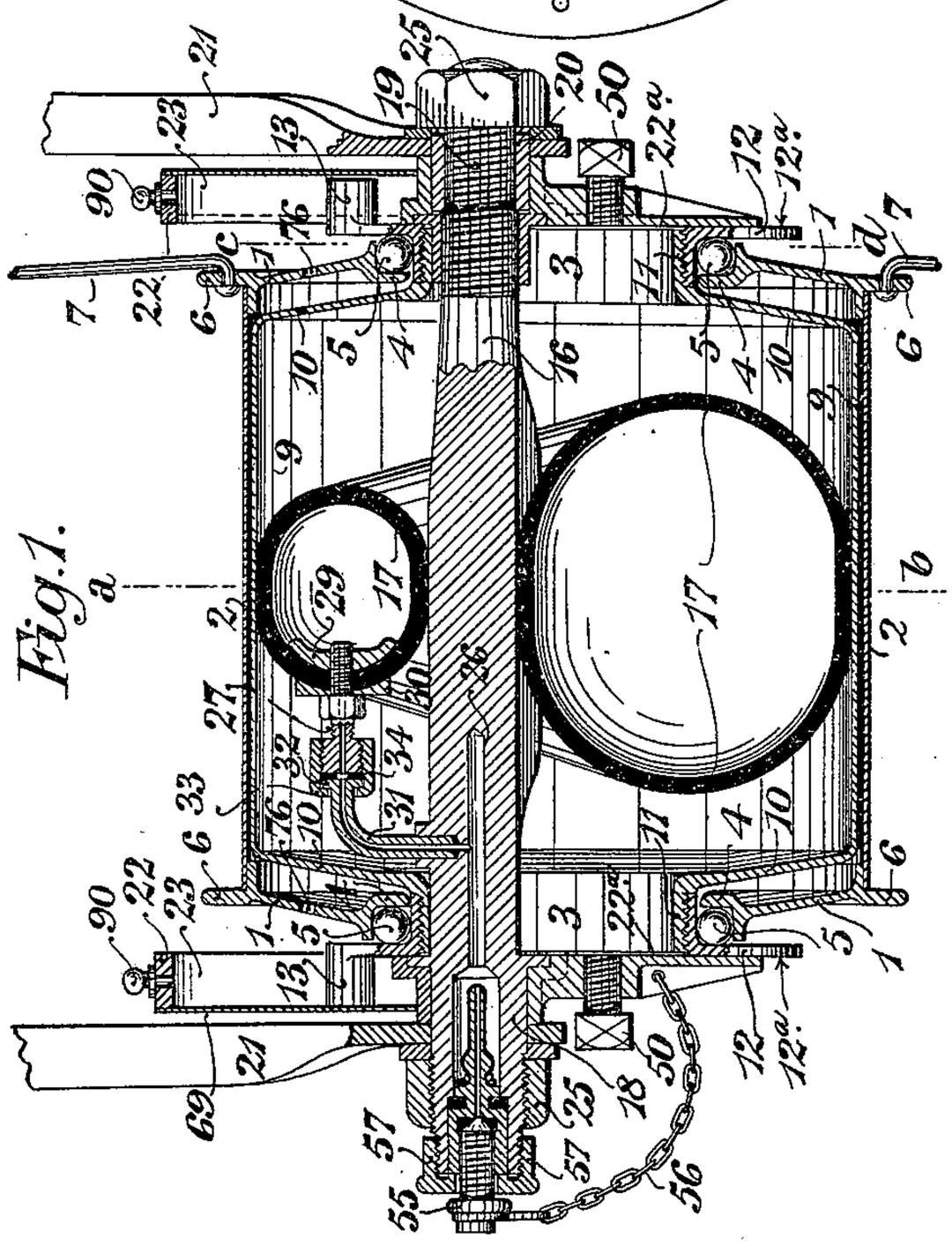
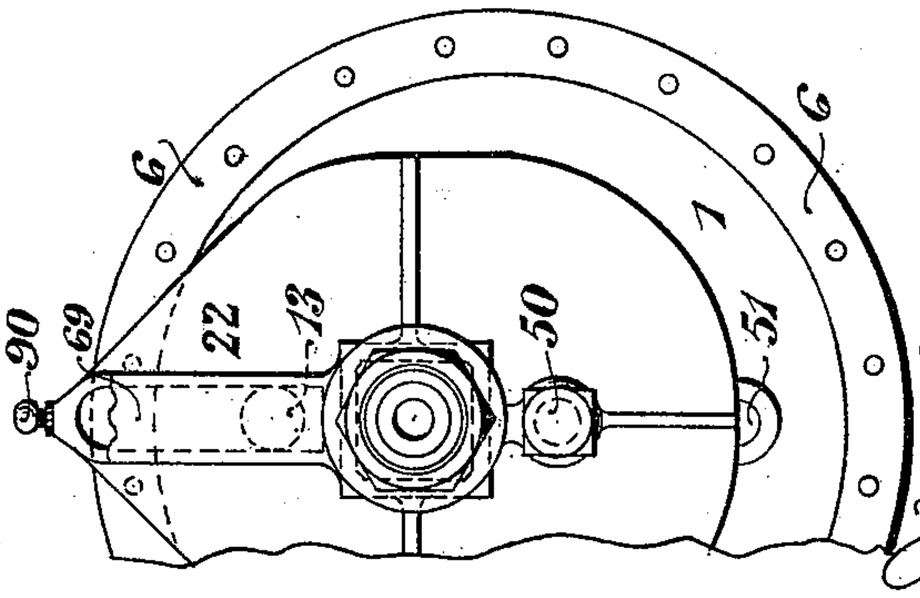


Fig. 2.



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No. 624,003. Patented May 2, 1899.

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(No Model.) 4 Sheets—Sheet 2.

Fig. 6.

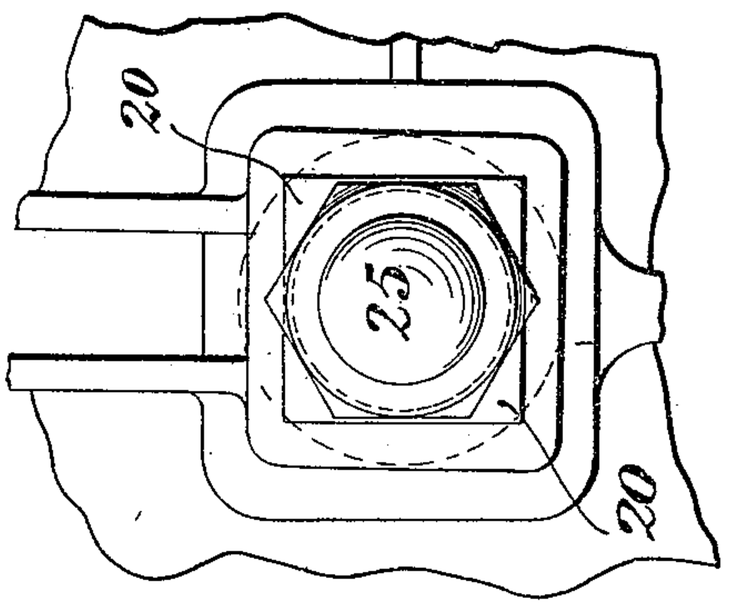


Fig. 5.

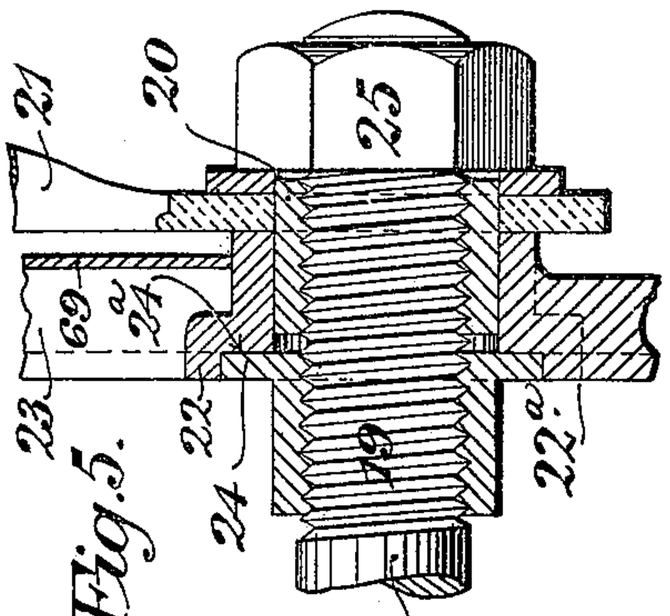


Fig. 4.

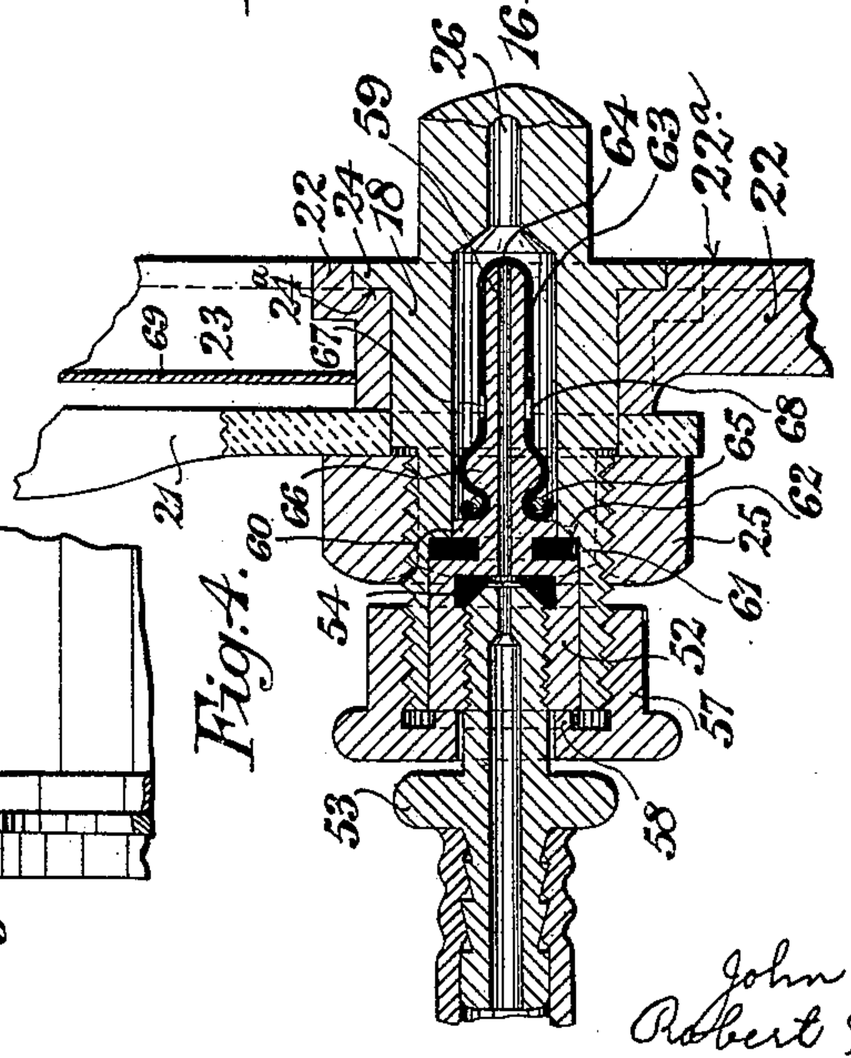
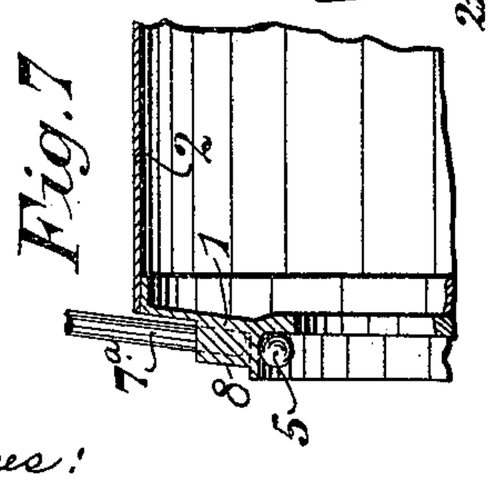


Fig. 7



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WHEEL CENTER.

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(No Model.) 4 Sheets—Sheet 3.

Fig. 10.

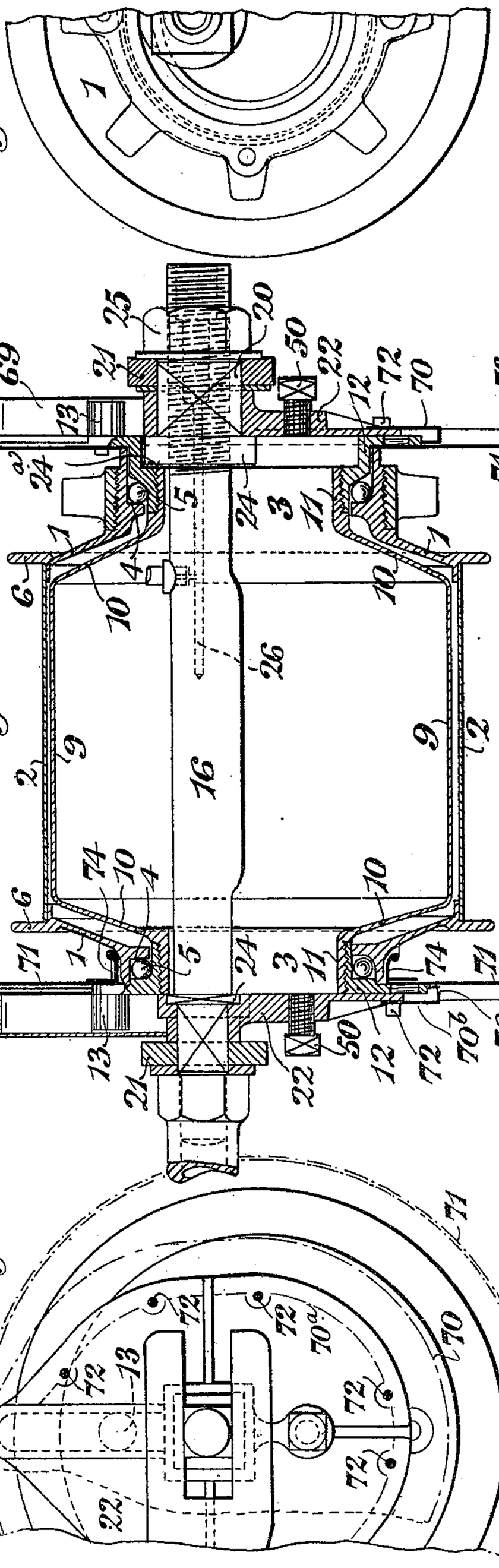

Fig. 8.

Fig. 9.

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No. 624,003. Patented May 2, 1899.

J. EVANS & R. W. HEALEY.

WHEEL CENTER.

(Application filed Mar. 23, 1898.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 12

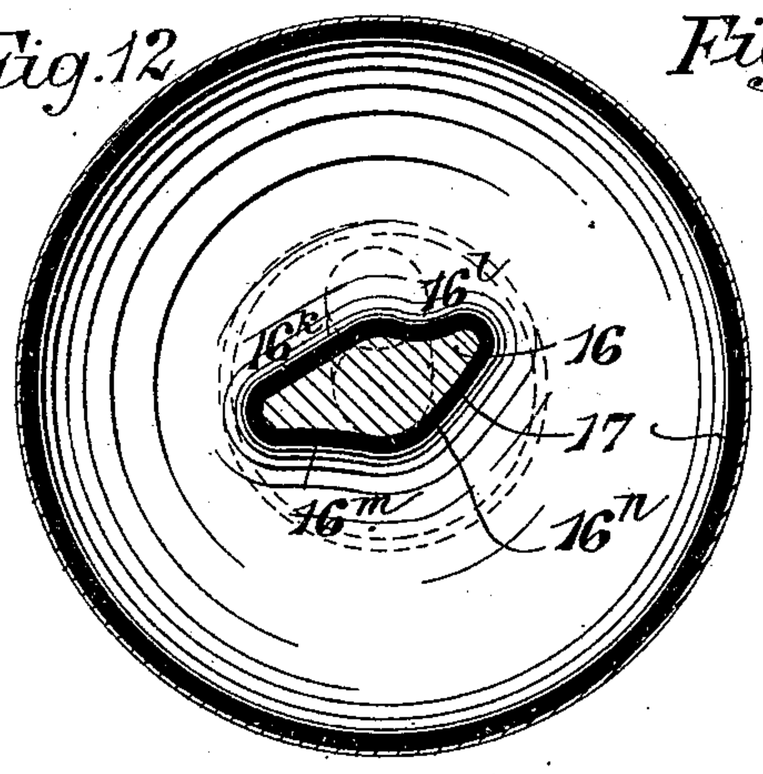


Fig. 11

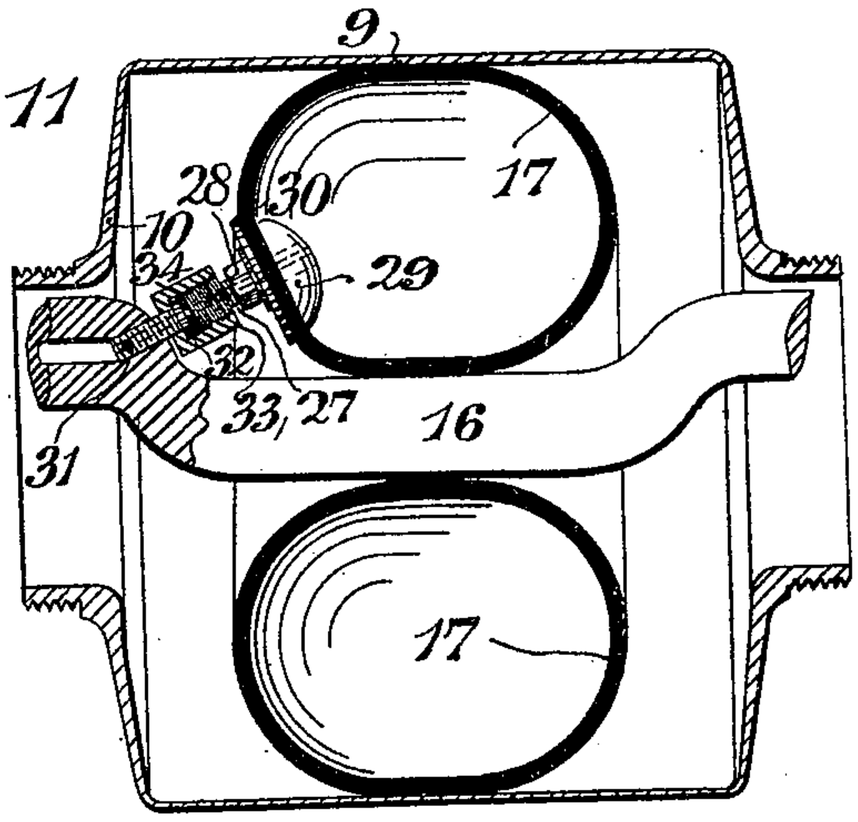


Fig. 19.

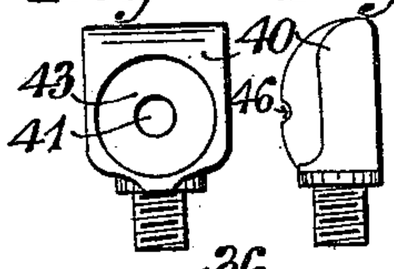


Fig. 20.

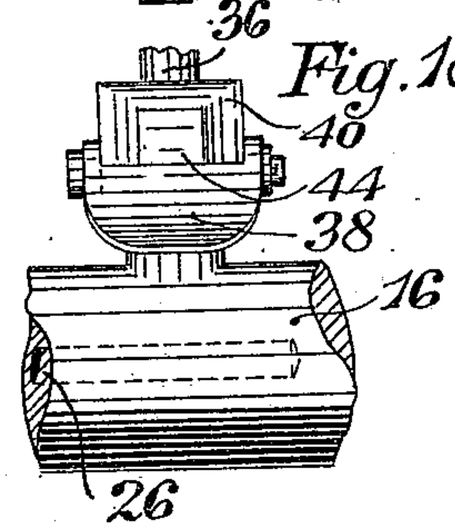


Fig. 18.

Fig. 16

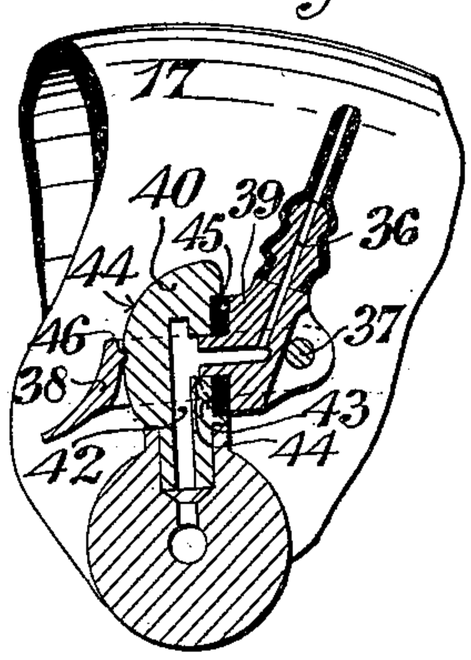


Fig. 17.

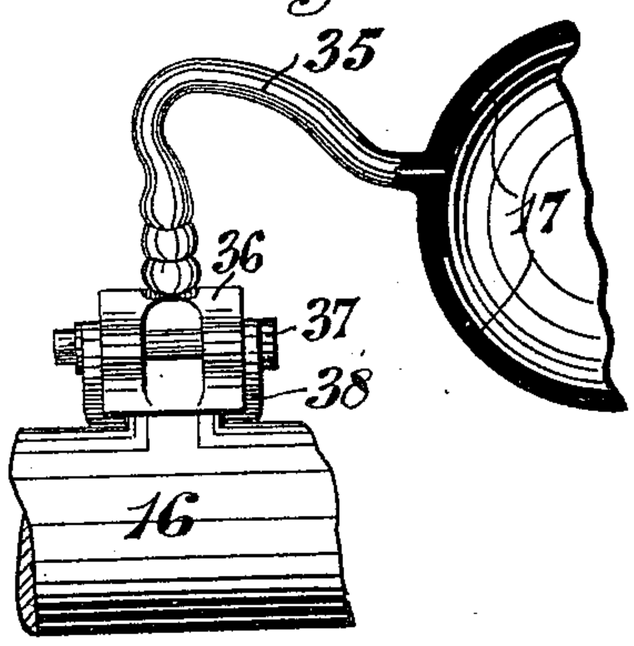


Fig. 13.

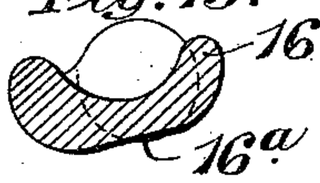


Fig. 14.

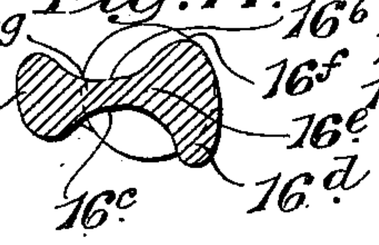


Fig. 15.

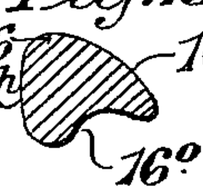


Fig. 25.

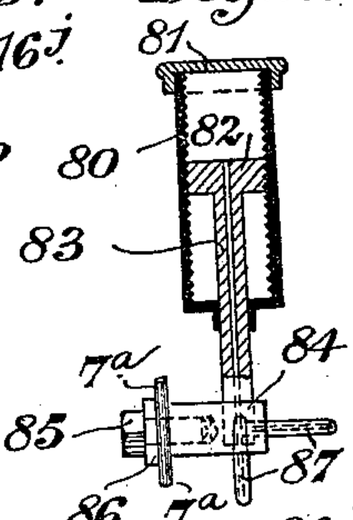


Fig. 27.

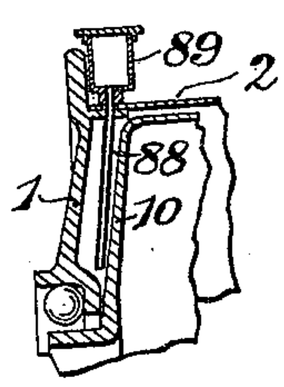


Fig. 22.

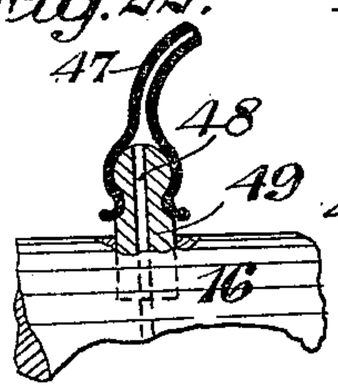


Fig. 21.

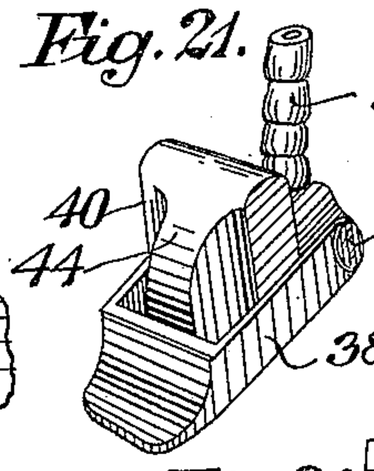


Fig. 23.

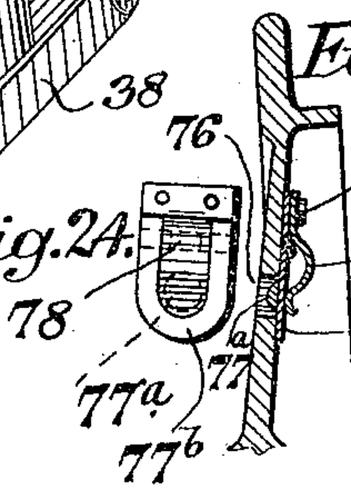
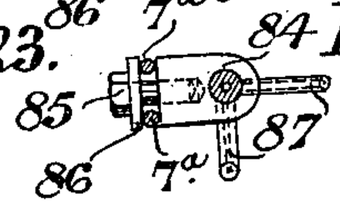


Fig. 24.

Fig. 26.



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UNITED STATES PATENT OFFICE.

JOHN EVANS, OF GRANGE TOWN, AND ROBERT W. HEALEY, OF SOUTH BANK, ENGLAND.

WHEEL-CENTER.

SPECIFICATION forming part of Letters Patent No. 624,003, dated May 2, 1899.

Application filed March 23, 1898. Serial No. 674,889. (No model.)

To all whom it may concern:

Be it known that we, JOHN EVANS, engineer, residing at Grange Town, R. S. O., and ROBERT WILLIAM HEALEY, draftsman, residing at South Bank, in the county of York, England, subjects of the Queen of Great Britain and Ireland, have invented Improvements in Wheel-Centers, of which the following is a specification.

This invention consists of improvements in pneumatic wheel-centers, and has for its object to impart to wheels provided with solid or cushion tires all the advantages that result from the use of pneumatic tires, while insuring them against the disadvantages, such as side slipping and punctures, attendant thereon.

Although the invention is specially designed for use in bicycles and tricycles, it is also applicable to other vehicles.

A pneumatic wheel-center according to this invention comprises a hub to which the spokes or their equivalents are secured and which has a large central aperture at each end, a casing around which the hub is intended to rotate and which has also a large aperture at each end, through which passes a spindle, which can fall and rise therein and which is secured, so as to be incapable of rotation, to the frame of the vehicle and is provided with a bore extending for a short distance from one of its ends and containing an air-valve, means for preventing the casing and hub from moving laterally on the spindle and for preventing the casing from rotating unduly about the spindle, and a pneumatic tube surrounding the spindle, supporting it within the casing, and connected with the bore of the spindle, so that when necessary it can be inflated through the valve. Means may also be provided whereby the casing can be rigidly secured to the axle in case the pneumatic tube burst and no fresh tube be available.

Figures 1 to 6, inclusive, of the accompanying illustrative drawings represent the center of a front wheel of a rear-driving bicycle constructed according to this invention, Fig. 1 being a longitudinal view thereof, principally in axial section, but partly in elevation; Fig. 2, a broken elevation of the left-hand end of the wheel-center, the valve and its plug and box-nut being removed; Fig. 3, half a section corresponding to the lines *a b* and half a section corresponding to the line *c d* of Fig. 1; Figs. 4 and 5, respectively, partial longitudinal sections, drawn to a larger scale, of the left and right hand ends of the wheel-center, an inflater having been substituted for the plug shown in Fig. 1; and Fig. 6, a partial elevation of the right-hand end of the wheel-center drawn to the same scale as Figs. 4 and 5. Fig. 7 is a section of a hub of modified form. Figs. 8, 9, and 10 represent the center of the rear wheel of a rear-driving bicycle constructed according to this invention, Fig. 8 being a longitudinal section thereof with the pneumatic tube omitted, Fig. 9 a partial left-hand end elevation of the wheel-center with the step removed, and Fig. 10 a partial right-hand elevation of the wheel-center with the right-hand fork and mud-guard removed. Figs. 11 and 12 show, respectively, in longitudinal section and medial cross-section modified forms of pneumatic tube and the spindle. Figs. 13, 14, and 15 show in medial cross-section other forms that may be given to the spindle. Figs. 16 to 21, inclusive, represent a connection between the bore of the spindle and the pneumatic tube, Fig. 16 being a longitudinal section, Figs. 17 and 18 partial front and rear elevations thereof, Figs. 19 and 20 elevations taken at right angles to each other of a part thereof, and Fig. 21 a perspective view of the hard or metal portion thereof. Fig. 22 is a section illustrating another connection between the bore of the spindle and the pneumatic tube. Figs. 23 and 24 are respectively a section and an elevation of a lubricating device. Figs. 25 and 26 show two sections at right angles to each other of an alternative lubricating device. Fig. 27 is a section illustrative of a third lubricating device.

The hub may consist of two somewhat conical end pieces 1, Figs. 1 and 8, connected together by a cylindrical piece 2 and each having a central aperture 3, of large diameter, around which is formed a race 4 for bearing-balls 5. Figs. 1 and 8 show the hub provided with flanges 6 for the attachment of tangent

spokes 7, which is the preferred construction, and Fig. 7 represents the hub adapted for radial spokes 7^a, the end piece 1 being provided with cavities 8 for the reception of the latter. The internal casing 9, which is preferably made of nickel-steel, may also be cylindrical, with conical end walls 10, terminating in cylindrical portions 11, having right and left handed screw-threads. The other portion of the bearing for each set of balls 5 is formed by a flange 12 of suitable material, such as case-hardened steel, which is screwed upon the corresponding portion 11 of the casing and which has an outer plane surface 12^a perpendicular to the axis of the hub and is provided with an outwardly-projecting pin 13, (hereinafter referred to,) that may either be formed in one with the flange 12 or be screwed or riveted thereto. In order to prevent the parts 11 and 12 from becoming unscrewed, a fixing-screw may be provided in the portion 11 of the casing, its inner end engaging with the screw-threaded part of the flange 12.

The spindle 16 may either be approximately straight, as shown in Figs. 1 and 8, or be bent or cranked, as shown in Figs. 11 and 12, so that when the spindle is in its highest possible position within the internal casing (see Figs. 11 and 12) the middle of the spindle, around which the air-tube 17 fits, is centrally within the casing 9. One end of the spindle may have a part 18, Fig. 4, made square in cross-section and the other 19, Fig. 5, be screw-threaded and have fixed upon it a square nut 20, so that the spindle will be prevented from rotating when these parts are fitted into the limbs 21 of the corresponding fork or corresponding portions of the frame of the vehicle, which should be correspondingly formed. On the part 18 of square section and the nut 20 of the spindle there may also be fitted two cheeks 22, stamped or otherwise formed out of suitable material, such as case-hardened steel, each of which has a vertical plane surface 22^a perpendicular to the axis of the hub and adapted to fit close against the vertical surface 12^a of the corresponding flange 12, whose pin 13 may engage in a vertical slot 23 in the cheek 22. The cheeks may be limited as to inward movement by flanges 24, secured to, Fig. 5, or formed in one with, Fig. 4, the spindle 16. These flanges may be received in recesses 24^a in the cheeks 22 and have their inner faces flush with the inner faces 22^a of the cheeks, but in the case of the driving-wheel of a bicycle it is preferred to form the recess 24^a for the flange at the chain-wheel end of the spindle in the corresponding flange 12 of the casing 9, Fig. 8, the boss of which is made specially long to accommodate the chain-wheel. In order to enable the distance between the cheeks 22 to be adjusted, the flange 24 of the spindle adjacent to the square nut 20 is preferably formed by a flanged nut, Fig. 5, or unflanged nut, Fig. 8, which is preferably milled and is screwed upon the spindle before the square nut 20 is placed thereon. The cheeks 22 and the vehicle-frame may be rigidly secured on the spindle 16 by nuts 25, which force the cheeks 22 tightly against the flanges 24 of the spindle.

The air or pneumatic tube 17 is preferably made of such a shape when the spindle 16 is practically straight, Figs. 1 and 8, that when it is inflated and the bicycle or other vehicle being not loaded the spindle is in its highest possible position within the casing the lower part of the tube is of considerably larger cross-section than the upper part, as shown in Fig. 1. When, however, the spindle 16 is bent or cranked, as hereinbefore described, the tube may, as shown in Figs. 11 and 12, be such as to be, with the spindle in the position just referred to, of equal cross-section in its upper and lower parts. The tube may be constructed in any suitable manner—*e. g.*, it may be a tube of rubber with an outer casing of strong thin fabric, a tube of rubber with inner and outer casings of fabric, a tube of fabric coated outside with rubber, or a tube of fabric coated inside and outside with rubber, or a tube of rubber with a separate outer cover of fabric. The tube preferably fits tightly, as shown in Figs. 3 and 12, on the middle portion of the spindle, which is preferably of such a cross-section as to prevent the tube from creeping or slipping around it. For this purpose its middle portion may be concavo-convex, with the convex surface 16^a either at the top, as shown in Fig. 3, or at the bottom, as shown in Fig. 13, the edges being suitably rounded, or its middle portion may, as shown in Fig. 14, have upper and lower concave surfaces 16^b and 16^c and somewhat resemble in cross-section a double-headed railway-rail placed on its side, the portion 16^d of the rear head below the axis 16^e of the spindle being somewhat larger than the upper portion 16^f and projecting somewhat rearwardly and the center 16^g of the section being somewhat in front of the axis 16^e of the spindle. Again, the middle portion of the spindle may, as shown in Fig. 15, be somewhat triangular in cross-section, having a front surface 16^h approximately vertical, a lower surface 16^i slightly concave and slightly inclining upward rearwardly, and an upper surface 16^j with a considerable downward inclination and forming with the lower surface a sharper edge than the two other edges. Furthermore and particularly, when the spindle is bent as hereinbefore described the middle portion may as a whole be, as shown in Fig. 12, somewhat downwardly and forwardly inclined, and its upper surface may have a flat or convex front portion 16^k and a concave or flat rear portion 16^l and its lower surface a flat or concave front portion 16^m and a convex or flat rear portion 16^n, the upper and lower surfaces being joined by rounded surfaces, or the middle portion may be of approximately uniform thickness, with its front and back edges turned upward and downward, respectively, its cross-section

showing a long central portion disposed horizontally below the axis of the ends of the spindle.

As an additional precaution against creeping a sheath of suitable material, such as steel, and adapted to fit the middle of the spindle tightly may be built in or secured to the pneumatic tube.

The connection between the interior of the pneumatic tube 17 and the bore 26 of the spindle 16 may be made in various ways. According to one construction (see Figs. 1 and 11) there is secured in the tube a short screw-threaded pipe 27, having on it two nuts 28 and 29, or a nut and a disk, and an intermediate washer 30. The disk or corresponding nut 29 is rigidly fixed on the end of the pipe 27, and is fixed permanently in position in the tube 17 while the tube is being made, the wall of the tube being clamped between it and the washer 30 by the nut 29. The outer end of the pipe is enlarged and externally screw-threaded. Another pipe 31, which may be flexible or not, is screwed into or otherwise secured to the spindle 17. Its outer end is provided with a flange 32 and a box-nut 33, which is screwed upon the enlarged end of the pipe 27 and produces a tight joint between it and the outer end of the pipe 31 by means of an interposed piece 34 of vulcanized rubber or soft metal or the like. According to another construction (see Figs. 16 to 21) a flexible pipe 35, suitably secured to the air-tube, terminates in a tubular and angular piece 36 of suitable hard material, such as metal, to which is pivoted at 37 a bridle-shaped lever 38 and which has a reduced free end forming a shoulder 39. In the spindle 16 there is secured a tubular piece 40, which has a hole 41 communicating with its bore 42 and surrounded by a recess 43 and which has an outer end surface 44 so curved that when the reduced outer end of the piece 36 is inserted into the hole 41 and the lever 38 is forced down along the curved surface 44 a rubber washer 45, placed on the outer end of the piece 36, will be compressed by the shoulder 39, so as to form an air-tight joint. A notch 46 is provided in the piece 40, in which a projection on the lever 38 engages when the lever is moved into its extreme position. (Shown in Figs. 16, 17, and 18.) Instead of being angular, as shown in Fig. 16, the piece 36 may be arranged horizontally. According to another construction (see Fig. 22) a flexible pipe 47, permanently secured at one end to the pneumatic tube 17, is secured at its other end over the outer end of a nipple 48, secured in the spindle 16, the flexible pipe 47 being wrapped with fine wire, twine, or other suitable material and thereby forced into an annular groove 49 or annular grooves in the nipple. India-rubber solution may be used in making the joint air-tight. The construction is preferably, as shown, such that when desired on deflating the air-tube 17 and removing the wheel-center from the frame and the cheeks 22 from the spindle 16 the connection between the bore 26 of the spindle and the air-tube 17 can be undone and the air-tube removed and another one put into its place through one of the end apertures 3 in the casing 9. In the bicycle-hubs shown by way of example to undo the connection the valve end of the spindle is drawn into the hub, so as to allow the hand to pass in through the corresponding opening 3.

In order to enable the cheeks 22 to be rigidly secured to the casing 9, so as to render the wheel serviceable when the air-tube has burst and no duplicate is available, each cheek may be provided with a set-screw 50 and the adjacent flange 12 with a corresponding tapped hole 51, the part of the flange surrounding the holes being preferably made thicker to provide a better hold for the screw. In order to prevent the screw 50 from entering the hole 51 when not required, a washer of suitable thickness is placed upon the said screw. This washer can be removed when it is desired to secure the parts 9 and 22 together. When lower guide slots and pins are used, a lug is formed near the bottom of each flange 12, at one side of the said lower pin, and provided with a tapped hole in lieu of the tapped hole 51, a corresponding tapped hole being formed in the adjacent cheek 22 to receive the set-screw 50.

The valve employed in the spindle may be of any suitable kind. According to one construction (see Figs. 1 and 4) it comprises a cylindrical body 52, that fits loosely in a recess in the corresponding end of the spindle 16, is tapped out to suit the screwed end of the nozzle 52 of an inflater, and contains a piece 54 of vulcanized rubber or soft metal—such as lead, tin, or white composition metal—shaped to allow the tapered end of the nozzle 53 to bed itself therein on being screwed up, and thereby to form an air-tight joint. A plug 55 may be normally screwed into the hole intended for the nozzle 53 and be attached to the adjacent check 22 by a chain 56. A milled box-nut 57 is screwed on the outer end of the spindle 16 and presses—it may be by means of an annular projection 58—against the valve, and thereby forces it into its place. A hole is made through this nut to allow the nozzle 53^a of the inflater to pass through. From the cylindrical body there extends a tubular portion 59, having near its outer end a flange 60, which fits in a portion of the bore of the spindle and between which and the cylindrical body there is a rubber ring 61, which is forced by the box-nut 57 against a shoulder 62 in the spindle, whereby an easily-breakable air-tight joint is produced. Over the inner and major part of the tubular portion there is stretched an elastic tube 63, which is closed at its inner end 64, there covering the end of the bore of the projecting tubular portion, and is secured at its outer end by strong fine twine, wire, or other suitable material wound around

the tube in a groove 65, formed between the flange 60 and an annular projection 66, formed on the projecting tubular portion. The elastic tube is perforated at 67 and 68 between its inner end and the annular projection 66, so that when air is pumped into the valve it passes through the small hole at the inner end 64 of the tubular portion 59, under the elastic covering 63, and out at the perforations at 67 and 68, but is prevented from returning by the back pressure on the elastic tube, which is pressed onto the tubular portion and forms an air-tight joint.

The ball-bearings and bearing parts of the cheeks 22 and the flanges 12 of the casing 9 may be protected from dust by means of thin plates 69, suitably secured, as by brazing, over the slots 23 in the cheeks, and of guards, which may be made of vulcanite, ebonite, or other light material, but are preferably made of transparent celluloid. Two pairs of guards are provided, each consisting of a guard 70, secured to a cheek 22, and another, 71, secured to the corresponding flange 12. (The guards are shown in section in Fig. 8 and indicated by chain-lines in Fig. 9.) The outer guard 70 of each pair extends around its cheek 22 and has two flanges 70^a and 70^b, which are arranged on opposite sides of the cheek and are perpendicular to the axis of the hub, and through the outer one of which pass set-screws 72, securing it to the cheek. The other guard 71 is a disk, which is fastened to the flange 12 by means of screws engaging in holes 71^a in the flange, bears against the inner flange 70^b of the guard 70, and is provided with a flange 73, that surrounds the guard 70 at a sufficient distance to allow of the free movement of the spindle 16 within the hub. It will, however, be understood that the outer guard 70 may overlap the inner one, 71, instead of vice versa. The inner guard 71 may also have a flange 74, passing around and fitting the adjacent end 1 of the hub to keep the ball-bearing free from dust. This flange may be dispensed with where a chain driving-wheel 75 is secured on the end of a hub, (see right-hand portion of Fig. 8,) as in that case the end of the hub preferably extends, as shown, considerably beyond the ball-bearing and fits over a correspondingly long boss on the flange 12 of the casing 9.

Any suitable means may be provided for oiling the ball-bearings. For example, each end wall 1 of the hub may have an oil-hole 76, Figs. 1 and 23, in it, and this hole may be normally closed by a cover 77, Figs. 23 and 24, which may have a piece of soft rubber 77^a secured to it to enter the oil-hole and make a tight joint therewith and which is normally pressed against the end wall of the hub by a spring 78, which may be secured at one end to the wall by screws 79, that also fasten the cover in place, or there may be provided an internally-screw-threaded cylindrical oil-cup 80, Fig. 25, which is provided with a removable cap 81 and in which fits an externally-screw-threaded and centrally-perforated piston 82, from which extends a tubular stem 83, that issues through the end of the cup remote from the cap 81 and is screwed at its outer end into a cross-piece 84, (see also Fig. 26,) which may be secured by means of a set-screw 85 and a small plate 86 to two of the spokes 7^a and from which one or two branch pipes 87 (two are shown) may lead to one or both of the ball-bearings. With this device oil is contained between the piston 82 and the cap 81, and when it is desired to supply oil to the bearing or bearings the cup 80 is screwed around the piston 82, so as to move the latter nearer to the cap 81, whereby oil is forced through the perforation in the piston 82 and along the stem 83 to the place required. Again, there may be provided for each ball-bearing a small tube 88, Fig. 27, arranged radially between the end wall 1 of the hub and the end wall 10 of the internal casing and secured to the cylindrical portion 2 of the hub at its outer end, where there may be attached to it an oil-cup 89, having a removable cap 89^a.

For oiling the pins 13 of the flanges 12 and the slots 23, in which they work, simple holes normally closed by plugs 90, Figs. 1, 2, and 8, may be provided in the cheeks 22 at the upper ends of the slots 23, or there may be screwed into each cheek at the same place an oil-cup having a removable cap similar to that shown in Fig. 27.

It will be seen that in a wheel having a pneumatic center according to this invention the wheel's proportion of the weight of the vehicle will be borne by the pneumatic tube 17, the lower portion of which will consequently be depressed, allowing the ends of the spindle 16 to assume a more or less central position within the apertures 3, and that should the wheel strike against a stone or other obstacle the hub and internal casing would swing backward, with the pins 13 as pivots, relatively to the frame of the vehicle and raise itself over the obstruction, the pneumatic tube being compressed in its forward portion and allowing the frame to travel forward with little hindrance until the obstruction be passed, whereupon the hub and internal casing would swing forward, with the pins 13 as pivots, into their normal position. The use of the pneumatic annular tube 17 and the swinging connection of the internal casing with the frame by means of the slots 23 and the pins 13 thus presents a considerable advantage over pneumatic wheel-centers in which the internal casing is allowed only up-and-down movement in relation to the frame, but no backward-and-forward movement in relation thereto.

What we claim is—

1. In a pneumatic wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is

adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube surrounding, and adapted when inflated to support the said spindle within the said casing, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, means for preventing the said casing and hub from moving laterally on the said spindle, and means adapted to allow the said casing to rotate partially, but to prevent undue rotation thereof about the said spindle, substantially as and for the purposes herein set forth.

2. In a pneumatic wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube surrounding, and adapted when inflated to support the said spindle within the said casing, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, means for preventing the said casing and hub from moving laterally on the said spindle, and means for allowing both up-and-down and forward-and-backward movement of the casing in relation to the spindle.

3. In a pneumatic wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube surrounding, and adapted when inflated to support, the said spindle within the said casing, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, a flange secured on each end of the said casing and having plane outer surface perpendicular to the axis of the said hub, a cheek fixed on the said spindle and having a plane inner surface in contact with the said outer surface, and a projection on the said cheek or the said flange engaging in a vertical slot or groove in the said flange or in the said cheek respectively.

4. In a pneumatic wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube surrounding, and adapted when inflated to support the said spindle within the said casing, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, a flange secured on each end of the said casing and having a plane outer surface perpendicular to the axis of the said hub, a cheek fixed on the said spindle and having a plane inner surface in contact with the said outer surface, a projection on the said flange engaging in a vertical slot or groove in the said cheek.

5. In a pneumatic wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube surrounding and adapted when inflated to support, the said spindle within the said casing, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, two flanges each secured on one end of the said casing and having a plane outer surface perpendicular to the axis of the said hub, two cheeks fixed on the said spindle and each having a plane inner surface in contact with the outer plane surface of one of the said flanges, means for adjusting one of the said flanges along the said spindle, and a projection on each of the said cheeks or each of the said flanges and engaging in a vertical slot in the adjacent one of the said flanges or of the said cheeks respectively.

6. In a pneumatic wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube surrounding, and adapted when inflated to support the said spindle within the said casing, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, means for preventing the said casing and hub from moving laterally on the said spindle, means adapted to allow the said casing to rotate partially, but to prevent undue rotation thereof, about the said spindle, and means whereby the said casing can be rigidly secured to the said spindle.

7. In a pneumatic wheel-center the combination of a hub having a large central aperture at each end, a casing about which the

said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube surrounding, and adapted when inflated to support the said spindle within the said casing, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, a flange secured on each end of the said casing and having a plane outer surface perpendicular to the axis of the said hub, a cheek fixed on the said spindle and having a plane inner surface in contact with the said outer surface, a projection on the said cheek or the said flange engaging in a vertical slot or groove in the said flange or the said cheek respectively, the said flange and the said cheek being provided with holes whereby the said flange and cheek can be secured together by means of set-screws or bolts.

8. In a pneumatic wheel-center the combination of a hub having a large aperture at each end, a casing about which the said hub can rotate and which has also a large aperture at each end, an approximately straight spindle which extends through the said apertures, is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube surrounding, and adapted when inflated to support the said spindle within the said casing and then to have with the said spindle in its highest possible position within the said casing, a lower part of considerably larger cross-section than its upper part, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, means for preventing the said casing and hub from moving laterally on the said spindle, means adapted to allow the said casing to rotate partially, but to prevent undue rotation thereof, about the said spindle.

9. In a pneumatic wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube adapted, when inflated, to fit closely around, and to support, the said spindle within the said casing, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, means for preventing the said casing and hub from moving laterally on the said spindle, which, where the said tube fits around it, has a cross-section adapted to prevent the said tube from traveling or creeping around it, and means adapted to allow the said casing to rotate partially, but to prevent undue rotation thereof, about the said spindle.

10. In a pneumatic wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube adapted, when inflated, to fit closely around and to support, the said spindle within the said casing, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, means for preventing the said casing and hub from moving laterally on the said spindle, which, where the said tube fits around it, has a concave surface and a convex surface one above the other and connected by rounded surfaces, the cross-section at this place being adapted to prevent the said tube from traveling or creeping around it, and means for preventing the said casing from unduly rotating about the said spindle.

11. In a pneumatic wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube adapted, when inflated, to fit closely around and to support, the said spindle within the said casing, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, means for preventing the said casing and hub from moving laterally on the said spindle, which, where the said tube fits around it, has an upper convex surface and a lower concave surface connected by round surfaces, the cross-section at this place being adapted to prevent the said tube from traveling or creeping around it, and means for preventing the said casing from unduly rotating about the said spindle.

12. In a pneumatic wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube which has secured to it a metal sheath fitting closely around the said spindle and is adapted, when inflated, to support the said spindle within the said cas-

ing, means for connecting the said bore with the interior of the said tube, a non-return valve adapted to allow air to be pumped into the said tube, means for preventing the said casing and hub from moving laterally on the said spindle, which, where the said sheath fits around it, has a cross-section adapted to prevent the said tube from traveling and creeping around it, and means adapted to allow the said casing to rotate partially, but to prevent undue rotation thereof, about the said spindle.

13. In a pneumatic wheel-center, the combination of a pneumatic tube, a spindle having a bore extending for a short distance from one of its ends, and a connection between the interior of the said tube and the said bore comprising a pipe secured to the said pneumatic tube, a tubular piece of hard material secured in the outer end of the said pipe and provided with a reduced free end forming a shoulder, a bridle-shaped lever pivoted to the said tubular piece, a second tubular piece secured in the said spindle, having a bore communicating with the bore of the said spindle, and provided with a hole communicating with its bore and receiving the said reduced free end, and a washer of compressible material on the said reduced free end and between the said shoulder and the said tubular piece secured in the said spindle, the last-mentioned tubular piece being provided with a notch, in which the said lever engages, and in proximity thereto with a curved surface adapted to allow the said lever, after being disengaged from the said notch, to turn toward and liberate the said pipe and also adapted to cause the said washer to be compressed against the last-mentioned tubular piece by the said shoulder when the said lever is again moved toward the said notch.

14. In a pneumatic wheel-center, the combination of a pneumatic tube, a spindle having a bore extending for a short distance from one of its ends, and a connection between the interior of the said tube and the said bore comprising a pipe secured to the said pneumatic tube, a tubular piece of hard material secured in the outer end of the said pipe and provided with a reduced free end forming a shoulder, a second tubular piece secured in the said spindle, which has a bore communicating with the bore of the said spindle, is provided with a hole communicating with its bore and receiving the said reduced free end, and has an outer curved surface terminating at its inner end in a notch, a washer of compressible material on the said reduced free end and between the said shoulder and the said tubular piece secured to the said spindle, a curved surface on the second-mentioned tubular piece, and a lever pivoted to the first-mentioned tubular piece, engaging in the said notch, and adapted to engage with the said curved surface, which is adapted to cause the said lever, as the lever passes toward the said notch, to compress the said washer between the said tubular pieces.

15. In a pneumatic wheel-center the combination of a hub having a large aperture at each end, a casing about which the said hub can rotate and which has also a large central aperture at each end, a spindle which extends through the said apertures, is adapted to be fixed so as to be incapable of rotation, to the frame of a vehicle, and has a bore extending for a short distance from one of its ends, a pneumatic tube adapted when inflated to fit closely around, and to support, the said spindle within the said casing, and, when deflated, to be removed through one pair of the said apertures, and a device, comprising two end pieces and a coupling, for connecting the said bore with the interior of the said tube, the aforesaid apertures being large enough to enable a person's hand to pass therethrough and operate the said coupling.

16. In a wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has a large central aperture at each end, a spindle which extends through the said apertures, and is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, means for elastically supporting the said spindle within the said casing, a flange secured on each end of the said casing and having a plane outer surface perpendicular to the axis of the said hub, a cheek fixed on the said spindle and having a plane inner surface in contact with the said outer surface, means for preventing the said casing from unduly rotating about the said spindle, and means for protecting the said surfaces from dust or mud.

17. In a wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has a large central aperture at each end, a spindle which extends through the said apertures, and is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, means for elastically supporting the said spindle within the said casing, a flange secured on each end of the said casing and having a plane outer surface perpendicular to the axis of the said hub, a cheek fixed on the said spindle and having a plane inner surface in contact with the said outer surface, means for preventing the said casing from unduly rotating about the said spindle, and a pair of dust or mud guards for protecting the said surfaces, one of the said guards being secured to the outer side of the said cheek, and the other of the said guards bearing all around against the first-mentioned guard and being secured to the said flange.

18. In a wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has a large central aperture at each end, a spindle which extends through

the said apertures, and is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, means for elastically supporting the said spindle within the said casing, a flange secured on each end of the said casing and having a plane outer surface perpendicular to the axis of the said hub, a cheek fixed on the said spindle and having a plane inner surface in contact with the said outer surface, means for preventing the said casing from unduly rotating about the said spindle, and a pair of dust or mud guards for protecting the said surfaces, one of the said guards being secured to the outer side of the said cheek, the other of the said guards being secured to the said flange, and one of the said guards having a flange parallel to the axis of the said hub and bearing against the other of the said guards.

19. In a wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has a large central aperture at each end, a spindle which extends through the said apertures, and is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, means for elastically supporting the said spindle within the said casing, a flange secured on each end of the said casing and having a plane outer surface perpendicular to the axis of the said hub, a cheek fixed on the said spindle and having a plane inner surface in contact with the said outer surface, means for preventing the said casing from unduly rotating about the said spindle, and a pair of dust or mud guards for protecting the said surfaces, one of the said guards being secured to the outer side of the said cheek, having a flange projecting inward perpendicularly to the axis of the said hub and surrounding the said cheek, and having a second flange at the inner end of the flange just mentioned and extending toward the axis of the hub perpendicularly or practically so thereto, the other of the said guards being secured to the said flange on the said casing, being of disk form, and being provided at its outer edge with a flange projecting outward perpendicularly to the axis of the said hub and surrounding the first-mentioned guard, and the two guards bearing against each other all around.

20. In a wheel-center the combination of a hub having a large central aperture at each end, a casing about which the said hub can rotate and which has a large central aperture at each end, a spindle which extends through the said apertures, and is adapted to be fixed, so as to be incapable of rotation, to the frame of a vehicle, means for elastically supporting the said spindle within the said casing, a flange secured on each end of the said casing and having a plane outer surface perpendicular to the axis of the said hub, a cheek fixed on the said spindle and having a plane inner surface in contact with the said outer surface, means for preventing the said casing from unduly rotating about the said spindle, and a pair of dust or mud guards for protecting the said surfaces, one of the said guards being secured to the outer side of the said cheek, the other of the said guards bearing all around against the first-mentioned guard and being secured to the said flange, and one of the guards secured to the said flanges of the said hub being provided with a flange fitting closely around the corresponding end of the said hub.

Signed at Middlesbrough, in the county of York, England, this 10th day of February, 1898.

JOHN EVANS.
ROBERT W. HEALEY.

Witnesses:
OSWALD H. COCHRANE,
THOMAS BELK.