Sept. 29, 1936. W. FENTON 2,056,064

ALARM AND INFLATION EQUALIZER FOR PNEUMATIC TIRES

Filed Oct. 15, 1932 4 Sheets-Sheet 1

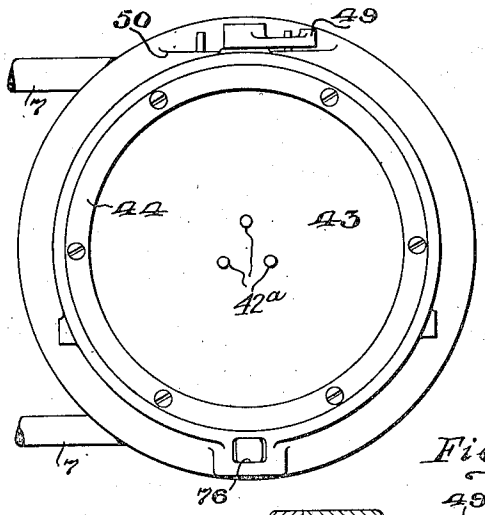

Fig. 3.

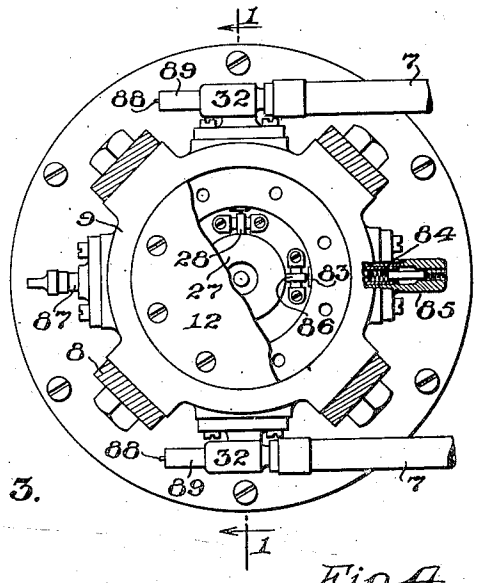

Fig. 4.

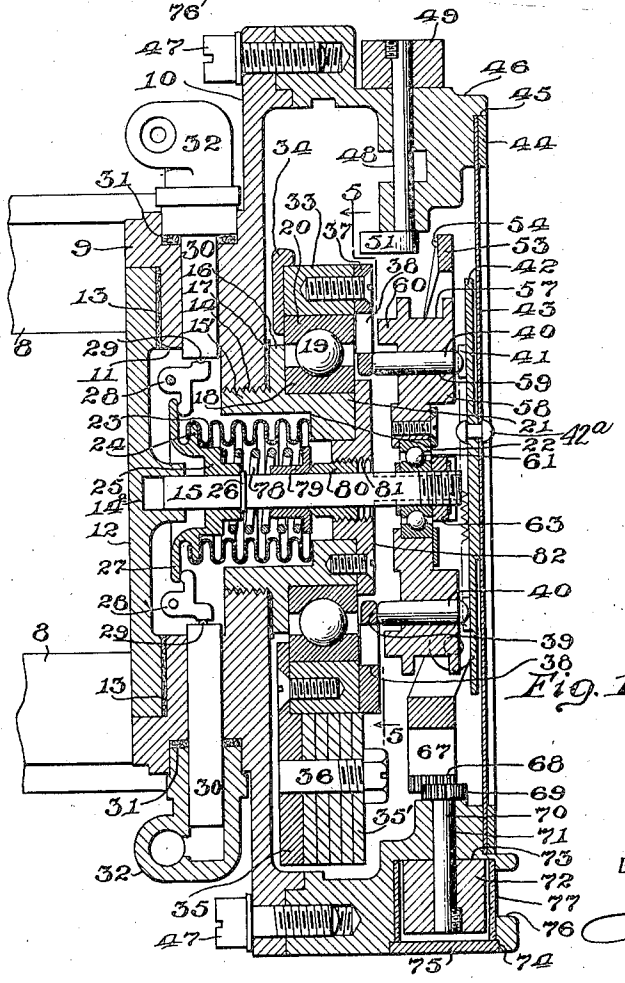

Fig. 1.

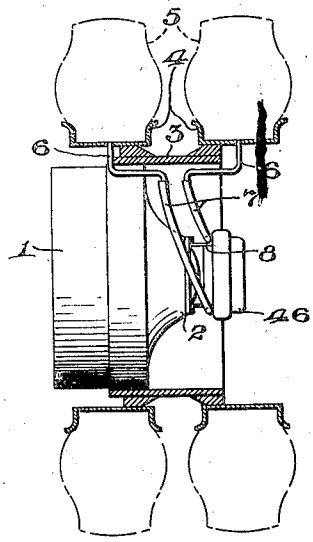

Fig. 2.

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Filed Oct. 15, 1932 4 Sheets-Sheet 2

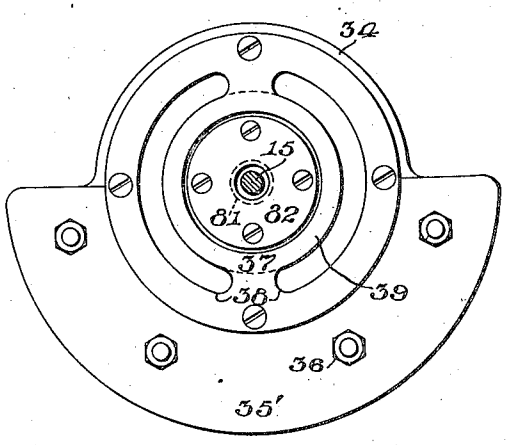

Fig. 5.

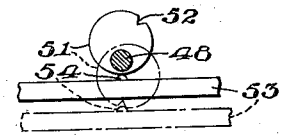

Fig. 6.

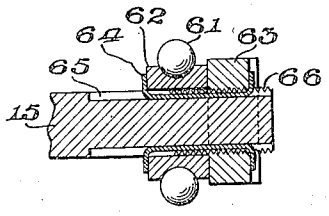

Fig. 8.

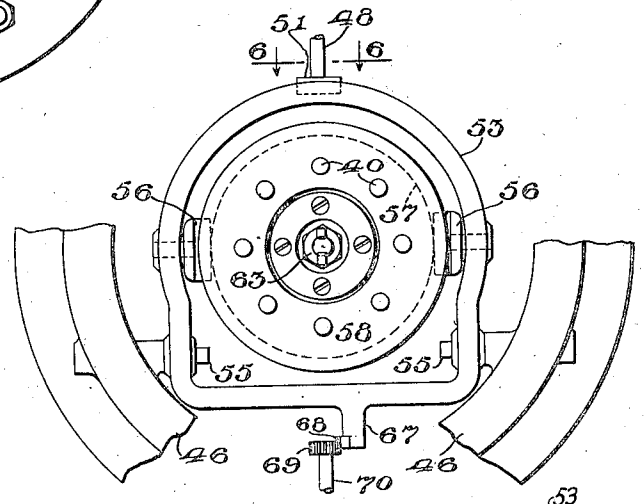

Fig. 7.

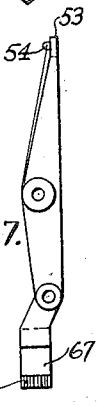

Fig17.

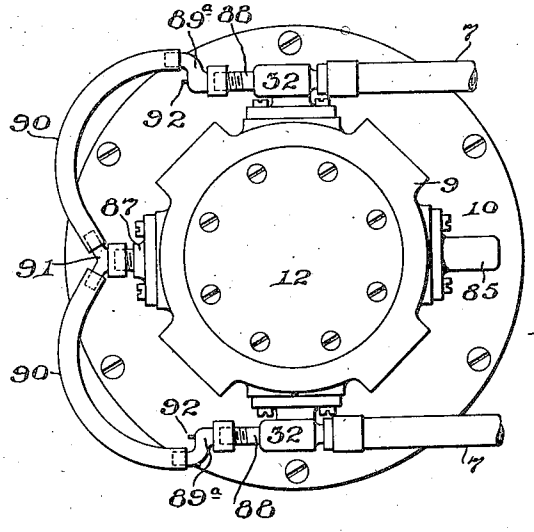

Fig. 9.

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ALARM AND INFLATION EQUALIZER FOR PNEUMATIC TIRES

Filed Oct. 15, 1932 4 Sheets-Sheet 3

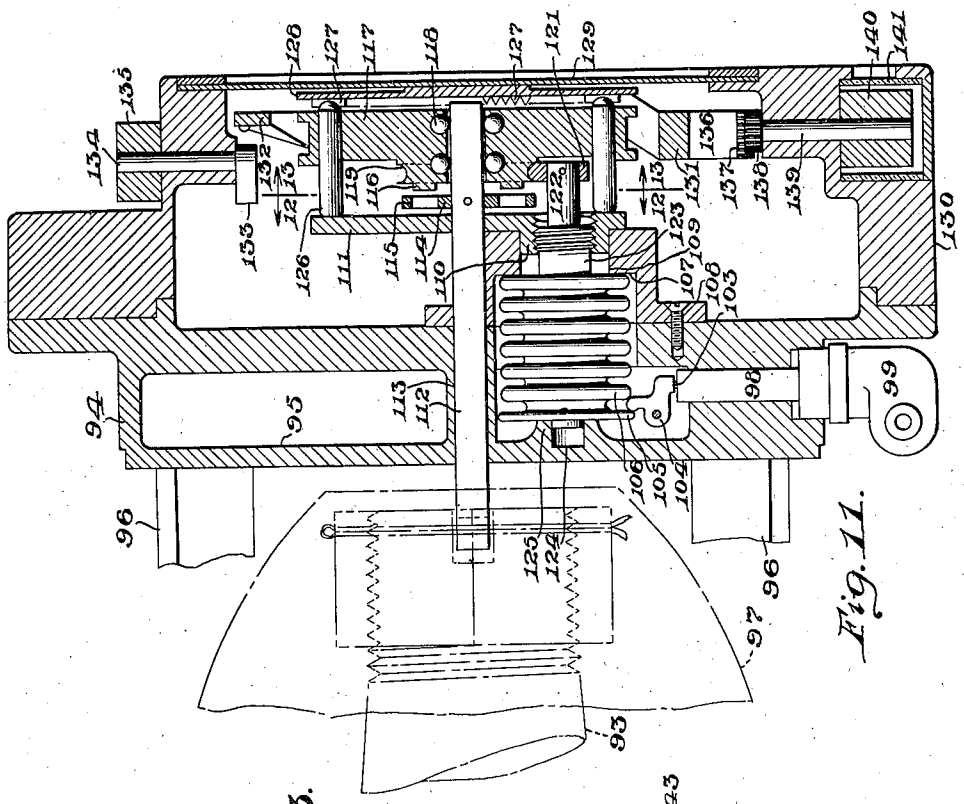

Fig. 11.

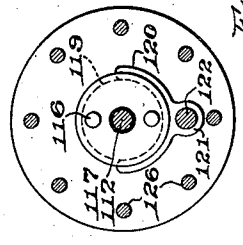

Fig. 13.

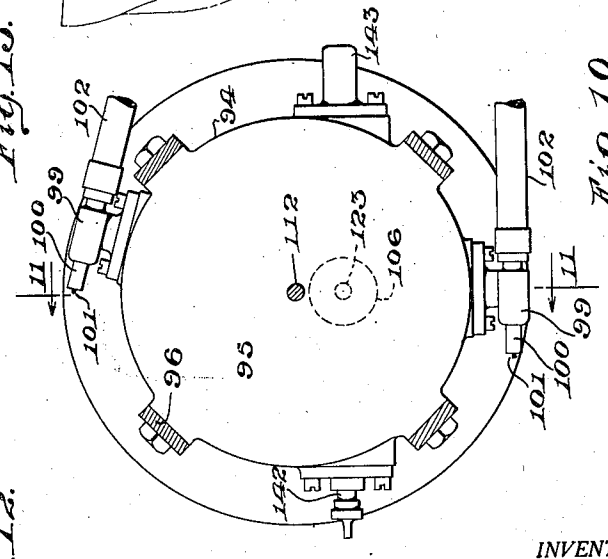

Fig. 10.

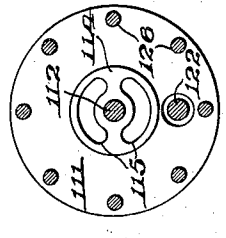

Fig. 12.

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ALARM AND INFLATION EQUALIZER FOR PNEUMATIC TIRES

Filed Oct. 15, 1932 4 Sheets-Sheet 4

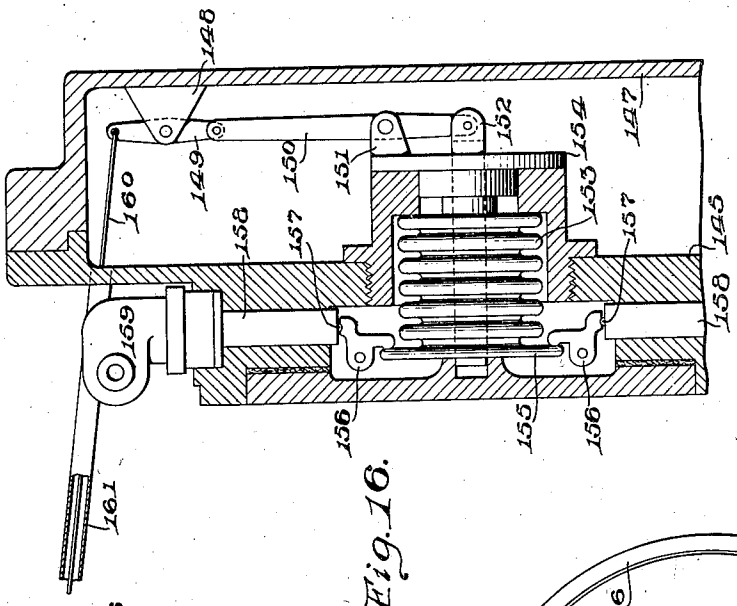


Fig. 16.

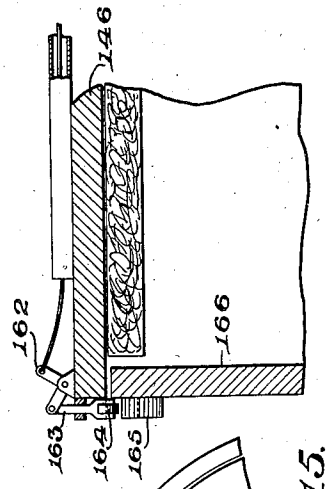
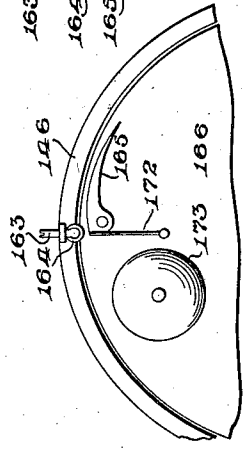
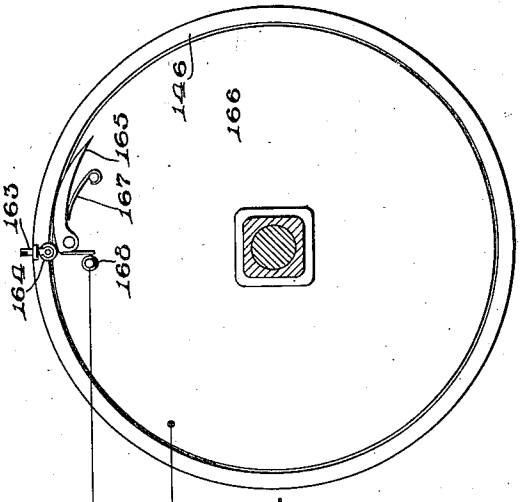


Fig. 15.





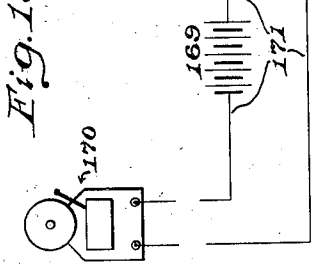


Fig. 14.

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Patented Sept. 29, 1936

2,056,064

UNITED STATES PATENT OFFICE

2,056,064

ALARM AND INFLATION EQUALIZER FOR PNEUMATIC TIRES

Warren Fenton, Philadelphia, Pa.

Application October 15, 1932, Serial No. 637,955

27 Claims. (Cl. 116—34)

The object of the invention is to provide improvements in alarms for pneumatic tires, particularly in combination with means and mechanisms such as will hereinafter appear.

Another object is to provide a device, which comprises an attachment for a plurality of tires, and which provides for the inflation of such tires simultaneously to the point of equalized operative air pressure, by means of but one attachment of the air supply hose or other connection.

Still another object is to provide a device which, when connecting a plurality of tires together, permits air to pass from one tire to another, in order to automatically equalize the pressure in such tires, as when a vehicle rests or runs upon uneven ground, crowned roads, or V-shaped driveways.

Again, another object is to provide a device which, when coupled to two or more tires, prevents the escape of air below a predetermined pressure from any and all other such coupled tires, when one is punctured or blows out, and simultaneously sounds an alarm.

Another object, on the other hand, is to provide a device which when attached either to one or more tires, sounds an alarm when the pressure in a tire falls below a predetermined point, as when punctured, or if deflation is reached while a car carrying the tire is stationary, the alarm immediately sounds upon the starting of the car and the resulting rotation of the wheel and tire.

A further object is to provide in such a device safety means for automatically exhausting air to prevent excess pressure, as when inflating a tire equipped with the device, or when fast driving in hot weather produces an expansion of the air due to an excessive rise in temperature; and in such a device to provide for failure of the safety means to operate, in which case a positively operating secondary exhaust mechanism functions.

Still further objects of the invention are to provide a manually operable means in such a device to shut off the alarm, as when it is desired to continue running the tire or tires a distance before changing the same; to provide a manually operable means to either or both shut off the alarm and to re-set the individual valves of the tires connected together by the device; to provide for ready attachment of the device to the wheels or hubs of a vehicle, without necessitating any change in the wheel, hub, or tires; to provide a slightly different form of the device adapted to be built directly in a wheel or hub; to provide a device of this character which is adapted to tires of all pressures from the lowest to the highest, by the mere setting of two simple adjustments; to provide a device embodying all of these features, and which when in operative position with respect to a plurality of tires, is shielded within the outer plane of the outer tire; to provide in such a device a visual air pressure gauge, to indicate the relative degree of pressure in the one or more tires to which the device may be attached, and operative from the minimum pressure at which the alarm is sounded up to the maximum operative pressure of the tire or tires, or the point at which the excess pressure under certain conditions is automatically released or exhausted; to provide a construction of such a device in which the internal mechanism is characterized by self-lubrication; to provide means for the application of a pressure gauge to each of the plurality of tires independently, after one has been deflated, in order to determine which tire must be replaced; and to provide further details of construction and operation, as will hereinafter appear.

The invention will be fully undestood from the following description, when read in conjunction with the accompanying drawings, in which Fig. 1 is a diametrical sectional view of a mechanism comprising one embodiment of the invention, taken on the line 1—1 of Fig. 4; Fig. 2 is a section taken thru a wheel, to the hub of which is attached the invention of Fig. 1, in operative relation to a pair of pneumatic tires shown in dot-and-dash lines; Fig. 3 is a front elevational view of the device per se; Fig. 4 is a rear elevational view showing the supporting brackets in section and with the back plate partly broken away; Fig. 5 is an elevational view of the pendulum per se on the line 5—5 of Fig. 1; Fig. 6 is a section on the line 6—6 of Fig. 7; Fig. 7 is a fragmentary elevational view of the front of the device with the diaphragm removed; Fig. 8 is an enlarged fragmentary sectional view of the forward end portion of the bellows shaft with its lock nut, ball race, and securing means; Fig. 9 is a rear elevation of a slightly modified form of the invention; Fig. 10 is a similar view of another modification of the invention; Fig. 11 is a section on the line 11—11 of Fig. 10; Figs. 12 and 13 are sectional views on the lines 12—12 and 13—13, respectively, of Fig. 11; Fig. 14 is a side elevation of the brake drum and backing plate of a wheel in association with an audible alarm and source of current, comprising a further modification of the invention; Fig. 15 is an enlarged fragmentary

portion of the same; Fig. 16 is a fragmentary sectional view of the same in operative association with a fragmentary portion of a modified form of alarm mechanism in diametrical section, and Fig. 17 is a side elevation of the pivotally mounted ring shown in Fig. 7.

Referring to Figs. 1 to 8 inclusive, a wheel 1 is shown as comprising a hub 2 and carrying a tire-supporting drum 3, to which latter are normally secured a plurality, but preferably two, demountable rims 4 carrying pneumatic tires 5, shown in dot-and-dash lines. The inner tubes of said tires are provided with angular inflation tubes 6, each having the usual valve which when associated with this device has its stem depressed by a suitable coupling of well-known construction, thus allowing air to escape into the device, and which coupling when disconnected allows said stem to close, and thus stop the outward flow of air from the tire. The tubes 6 are then connected by means of flexible tubes 7 to the combined inflation and alarm mechanism hereinafter described.

This mechanism is mounted upon the hub 2 by means of suitable brackets 8, the outer ends of which are secured in any desired manner to the cylindrical flange portion 9 of the rear wall member 10 of the mechanism casing. Said flange portion 9 is provided with a recessed planular shoulder 11, to which are secured a back plate 12 and an intervening air-tight gasket 13, said plate being provided with a central inwardly extending boss, into which extends from its inner surface a bearing recess 14a for the reception of the shaft 15 supporting the bellows, pawl carrying disc, etc.

The rear wall 10 extends radially inwardly beyond its flange 9 and surrounds a threaded aperture 14, in which is secured a hollow circular member 15', having a central radially outwardly extending flange 16, spaced from the inner surface of the member 10 thru the medium of an air-tight gasket 17, and beyond said central flange providing an exterior supporting surface for the inner ring 18 of a ball bearing unit, comprising balls 19 surrounded by the usual outer ring 20. Said member 15' inwardly terminates in a radially inwardly extending flange 21, providing an annular shoulder 22 to which is secured in air-tight relation one end of a circumferentially corrugated, longitudinally expansible bellows 23, the outer end portion of which bellows surrounds and is similarly secured about a flange 24 of a ring 25, which is also rigidly secured in air-tight relation to, and abuts against a cylindrical flange 26 upon, the shaft 15.

The ring 25 is recessed upon its normal rear surface in order to receive and pass over the boss upon the back plate 12, and is provided with a radially outwardly extending flange 27, spaced from the flange 24 and adapted to bear against the inner arms of bell crank levers 28, which are pivotally supported by the wall member 10 in any suitable manner, and have their respective outer arms adapted to bear against and depress under certain conditions the elongated stems 29 of ordinary pneumatic inflation valves 30, such as those widely known as Dill and Schrader valves, and which in turn extend radially thru and are secured to the flange portion 9 of said member 10. These valves extend through air-tight gaskets 31, and are provided with angular terminals 32. These terminals are then attached to the free ends of the flexible tubes 7, and it will be noted that the space surrounding said bell crank levers is normally filled with air under pressure, while said valve stems are depressed.

Surrounding the outer ring 20 of said ball bearing unit and secured thereto is a ring 33, to the rear surface of which is secured the annular portion 34 of a plate extending partially over said ring, from the normal lower portion of which plate extends an integral portion 35, comprising a radially enlarged semi-circular sector, to which is secured a weight 35' of the same shape and formed, either of a single piece or of laminations, duly secured together by bolts 36. Obviously by reason of its ball bearing support, this weighted annulus tends to remain in a given or relatively fixed position with respect to the axle of the vehicle, while the surrounding parts of the device normally rotate with respect thereto, thereby normally making said annulus and the remainder of the device relatively rotatable, under the force of gravity acting upon said weight.

To the outer face of said annulus is secured an annular member 37, provided with a plurality of spaced, circumferentially aligned arcuate slots or grooves 38, spaced from the radially inner marginal edge portion of said member by means of a bearing track 39, for and against which bear the inner ends of pins 40, comprising pawls which are parallel with each other and with the axis of the device. The outer ends of these pawls are adapted to engage the circumferentially disposed ratchet teeth 41, carried by the inner surface of a disc 42, the central portion only of which is in contact with and is secured as by rivets 42a to a resonant diaphragm 43, which comprises a closure for the normal outer portion of the casing of the device, the radially outer edge of which diaphragm if desired being directly secured by means of a plate 44 to, and preferably within an annular recess 45 in the peripheral portion of a casing member 46, which is in turn secured to the corresponding portion of the rear wall member 10 by means of screws 47, or otherwise as may be desired. However, louder and better tonal effects are obtained under some conditions by separating the diaphragm peripherally from the plate 44 and casing 46 by one or more rubber gaskets, in accordance with accepted practice in talking machine sound reproducers, thus preventing the diaphragm from contacting with other metal parts, other than a minimum portion of the ratchet plate 41.

Extending radially thru the cylindrical wall portion of the said casing member is an axially oscillatable rod 48, to the outer end of which is secured a manually engageable lever 49, normally shielded to a large degree within a recess 50 in said member, while the inner end of said rod terminates in an eccentrically positioned cam 51, preferably having a notch 52 at one point of its periphery. The peripheral surface of this cam is adapted in certain positions to engage the adjacent surface of, and to thereby shift, an irregularly shaped ring lever 53, and said notch to receive a lug 54 carried by said lever, which is pivotally mounted upon trunnions 55, carried by and extending inwardly from said casing member 46 (Fig. 7). At intermediate points between said trunnions and the uppermost free end portion of said lever, where said lug is located, the sides of said lever are provided with trunnion blocks 56, upon the diametrically opposite sides of and directed radially into a circumferential groove 57, in the outer surface of a centrally disposed disc 58.

Said disc is provided with spaced parallel bores 59 in which the pawls 40 are reciprocatably carried, and is provided upon its inner surface with lugs 60, which at certain times enter the arcuate slots 38 in the annular member 37, as hereinafter described. The central portion of said disc is cut out and therein is secured in any suitable manner the outer ring of a ball bearing unit 61, the inner ring 62 of which surrounds the outer end portion of the shaft 15, and abuts against a set nut 63 (Fig. 8), which with said inner ring is spanned by one or more U-shaped keys 64, the central portions of which are slidable in parallel grooves 65 in said shaft, under the influence of said nut when in engagement with screw threads 66 upon the adjacent end portion of said shaft. Thus, adjustment of said nut 63 upon the shaft 15 operates to nicely adjust the inner surface of the lever 53 with respect to the cam 51, and the lugs 60 with respect to the adjacent slotted surface of the annular member 37.

The lever 53 at any suitable point below the supporting trunnions 55 is provided with an extension 67, which carries a rack 68 in mesh with a pinion 69, in turn carried by a shaft 70, which passes radially thru a bore 71 in said casing member 46, the outer end portion of said shaft being provided with a unitarily secured drum 72, provided with any desired form of indicating indicia for a purpose hereinafter described. This drum is mounted within a cylindrical recess 73 within the casing member 46, and said recess opens thru said member radially by way of an aperture 74, normally spanned by a closure 75, while said recess also opens forwardly thru an aperture 76, so that the surface of said drum may be viewed from the diaphragm (43) side of the device, said last-named aperture being closed by a transparent cylinder 77 of glass or the like, which surrounds said drum within said cylindrical recess.

Finally, it will be seen that the ring 25 and shaft 15 are maintained in their innermost position, when the air pressures in the tires and that surrounding said bellows are unequal, under the influence of a coil spring 78, which extends between said ring and the flange of a collar 79, which surrounds said shaft and is adjustably positioned thereupon by means of a set nut 80, in the form of an externally threaded sleeve which similarly surrounds said shaft, and is in adjustable threaded engagement with the threaded bore 81 of a plate 82, which is secured to the forward or outer surface of the cylindrical member 15'. This construction makes it possible to construct and carry in stock a device of this character in but one size, and by suitably adjusting said sleeve nut 80, to adapt the device to the protection of tires requiring widely different operating air pressures.

Referring to Fig. 4, it will be seen that a safety valve 83, maintained in closed position by a spring 84, positioned within a suitable housing 85, communicates with the interior of the device outside of the bellows 23, thru the flange portion 9 of the rear wall member 10. However, if for any reason the valve 83 should fail to release excess air pressure super-inflation would be positively prevented by reason of the said valve being indirectly actuated by the cooperation of the flange 27 of the ring 25 therewith thru the medium of a third bell crank lever 86, similar in shape, mounting and operation to the levers 28, hereinbefore referred to, and operatively engaged by said flange. Upon the diametrically opposite side, said device is provided with an ordinary inflating valve 87, which also of course communicates with the interior of said device upon the outside of the bellows 23, and as said safety valve is set for a predetermined pressure at which the tires are desired to operate, injection of pressure thru the inflating valve beyond such operating pressure merely causes the automatic release of said safety valve, so that any such excess pressure readily escapes therethru and prevents super-inflation.

In the operation of this device, it will be assumed that at the start the device is attached to a plurality of (in this instance, two) tires with both of said tires inflated, the relation of the parts of said device being as shown in Figs. 1 to 8, inclusive; also, that the pressure from a supply line thru the single valve 87 into the space around said bellows has partially collapsed said bellows into the position shown in Fig. 1, so that the ring flange 27 depresses each of the levers 28 and the cooperating valve stems 29. However, as long as the pressure designed for the tires, and for which pressure the device has been adjusted by properly setting the nut 80 is not exceeded, said flange 27 does not bear against the lever 86 sufficiently to open the safety valve 83, tho if too great pressure should continue to be forced into the device, and said safety valve should not immediately respond thereto, said ring flange and lever will positively actuate the same, and thus release the excess pressure.

With both of the levers 28 depressed, it will be evident that the pressures within the two tires are equalized, and therefore if the vehicle encounters and passes over a crowned road, or other irregularity, the tire receiving the greater external pressure, and which would ordinarily experience a correspondingly increased internal pressure, automatically releases a sufficient portion of its own air pressure thru its valve, and thru the space around said bellows, and thru the valve of and into the other tire, to continue the maintenance of equal pressure in both tires, until another external pressure condition shall cause an additional flow of air in the same direction, or a recession of the air in the opposite direction.

With the existence of this condition of operation and the bellows partially collapsed, against the tension of the spring 78, the shaft 15 is in a right-hand position (as viewed in Fig. 1), and the disc 58 has its lugs 60 free from engagement with the slots 38 in the annular member 37, so that gravity in acting upon the pendulum weight 35' maintains the annular members 34 and 37 in relatively stationary position, as the remaining parts of the device rotate in accordance with the wheel 3 and tires 5. Now, if one of the tires is punctured or "blows out", its pressure immediately decreases and thereby bleeds air from within the device surrounding the bellows, thus permitting the spring 78 to force the ring 25 inwardly or towards the left (as shown in Fig. 1), and accordingly the shaft 15 with the disc 58, until the lugs 60 of the latter enter the slots 38, and upon engaging the ends of said slots cause said disc, normally rotating with the supporting wheel and diaphragm 43, to cease rotating with the diaphragm and instead remain stationary with relation to and by virtue of the stationary force or inertia of the pendulum, and thereby cause the pawls 40 to rotate (relatively speaking) with respect to the ratchet teeth 41 which in reality rotate with the wheel, with the result that very rapid vibrations are imparted

to the diaphragm 43 thru the medium of the plate 42, causing sufficient sound to reach and warn the driver of the vehicle that one or both of the tires has become deflated.

Upon hearing this alarm, the driver will usually stop his vehicle as soon as possible, and by depressing the stem 88 of each of the test valves 89 of the angular terminals 32, he can determine which of the tires must be replaced. Thereupon, he will if possible dismount the deflated tire and mount and connect a fresh tire to the device by means of the tube 7 as in the first instance. The fresh tire it will be assumed is already inflated at operating pressure or above. After this tire is placed in operative position and duly connected, manually turning the lever 49 for a moment will both release the alarm by virtue of its cam 51 shifting the disc 58 outwardly, so that its lugs are again free from engagement within the slots 38, and also thru the shaft 15 and ring 25 cause the valve stems 29 to be depressed, thereby permitting enough of the pressure within the fresh tire to pass thru the device and partially re-inflate the old tire remaining upon the wheel, until the pressures in the two tires are equal, the lever 49 and thereby the cam 51 then being returned to their normal positions (Figs. 1 and 3), and the pressures in the two tires then combining to hold the alarm disc 58 in inoperative or outer position, as before described. The vehicle can then be driven to the nearest or suitable air-filling station, where the air supply pipe will be connected to the valve 87, and the pressure simultaneously raised in both tires to the desired degree. The desired pressure can be determined, either by the use of a separate pressure gauge, or upon the exhausting of excess air past the safety valve 83, or the appearance of "Full" or some similar indicium upon the drum 72 thru the window aperture 76. Note, however, that if the pressure in the spare tire is sufficiently above normal operating pressure, equalization will bring both tires to operating pressure, upon operatively mounting the spare tire and manipulating the device as described.

On the other hand, if the driver does not have a good spare tire, or is unable without aid to change the deflated tire for another, he will upon hearing the alarm dismount, probably tho not necessarily note which of the tires requires changing, and by turning the lever 49 only until its notch 52 engages and receives the lug 54, re-set or release the alarm by effecting a withdrawal of the lugs 60 from within the slots 38, as before, but without shifting the disc 58 sufficiently to depress the valve stem 29 of the inflated tire, and thereby releasing the air pressure stored therein. However, when he finally reaches a locality where he can conveniently change the deflated tire, or where he will have the help needed, he will effect such change and then further turn said cam 51 until the valve stems 29 are depressed, as in the case previously described, after which said lever and associated cam will be returned to their normal positions as before.

In constructing this device, if the pawls and ratchet teeth are properly shaped, said device is made interchangeable for use upon wheels upon either the right or left sides of a vehicle. Also, the same size device of this construction is made adaptable for tires of widely different air pressures, by removing the diaphragm 43, nut 63, and disc 58, so that by means of a suitable spanner wrench the nut 80 can be adjusted, to thereby vary the tension upon the spring 78 and correspondingly the pressures at which the bellows will respond in automatically shutting off one of the valves 30, when the tire of the other such valve is deflated below a predetermined pressure. After such setting, the said disc and diaphragm are replaced and the device is placed in operation as before.

Referring to Fig. 9, a construction is here shown which is similar in design and function to that hereinbefore described, but without there being present any manually operable means such as the lever 49 for indirectly re-setting the valves 30 by depressing their respective stems, as described, for the purpose of equalizing the pressures in the tires attached to said valves, following the substitution of a new or inflated tire for one that has become deflated for any reason. In this case, the exposed valve terminals 32, in addition to being connected by tubes 7 to the respective tires, as above described, are themselves provided with auxiliary valves to which couplings 89a detachably secure tubes 90, which in turn are normally connected thru a common Y-shaped coupling 91 with the central inflation valve 87. It will be noted that the stems 92 of the valves 88 extend thru the respective couplings 89a for manual actuation when desired, and that the coupling 91 is attached to said inflation valve except when it becomes necessary to inflate both tires, after one or both of them have been replaced upon the wheel and their internal pressure equalized. This equalization of pressure, following the attachment of an inflated tire to a wheel in combination with one in which the pressure has become diminished, as above described, is accomplished by manually depressing for a moment the valve stem connected to the inflated tire, thereby permitting some of the air under relatively high pressure to rush into the chamber surrounding the bellows 23, which thereupon contracts and depresses the stems of both of the valves 30, as a result effecting and thereafter maintaining such equalization of pressure in the two tires.

Referring now to Figs. 10, 11, 12 and 13, a construction is here shown which does not depend upon the presence and use of a gravity-actuated pendulum as a relatively stationary element, tho the use of this form of the device is limited to vehicles in which a stationary axle 93 extends thru and is accessible from the outside of the wheel which surrounds such axle. In this instance, a back plate 94, having an internal circumferentially extending chamber 95, is secured by spaced brackets 96 to any suitable points upon or built in the hub 97. Spaced ordinary pneumatic inflation type valves 98 extend radially thru the outer walls of this back-plate into said chamber, and upon their outer ends carry terminals 99, themselves being provided with valves 100, having freely extending, manually engageable stems 101, and also connected by tubes 102 to the respective tires, as in the cases above described. The stem 103 of each of the valves 98 engages one arm of a bellcrank lever 104, pivotally mounted within the chamber 95 and having another arm in engagement with a flange 105, attached to a bellows 106 which at its opposite end abuts against a shoulder 107 of a circular member 108, secured to the inner surface of said back-plate and provided with an axial opening 109, closed by the axially apertured boss 110 of a plate 111. As the position of said bellows is eccentric with respect to the axis of the back-plate, said boss is eccentric with respect to said last-named plate.

A shaft 112 has one end rigidly secured to said

axle 93 and extends thru a centrally disposed bore 113 in said back-plate, its opposite end extending thru the plate 111 and securely carrying adjacent thereto a disc 114, having circumferentially spaced apertures 115, adapted to receive the lugs 116 of a disc 117, reciprocatably carried by the outer end portion of said shaft 112, thru the medium of anti-friction means 118. Said last-mentioned disc is provided with a peripheral groove 119, in which is slidably positioned a yoke 120, having an offset or enlargement 121, which is secured to the outer free end of a shaft 122, in turn extending axially thru an adjustable nut 123, in the threaded aperture of the boss 110. Said shaft 122 thence extends thru the bellows 106, is secured to the flange 105 and has its opposite end slidably positioned within a recess 124 in a box 125, forming an integral inward extension of the rearward wall of the back-plate 94. Thus, upon the inward extension of said bellows thru expansion under the influence of a coil spring, similar to the spring 78 of Fig. 1, upon a lowering of the pressure surrounding said bellows, the shaft 122 is forced inwardly, or to the left as viewed in Fig. 11, thereby shifting the disc 117 in the same direction, so that the lugs 116 enter the apertures 115 in the disc 114, and thereby arrest the normal rotation of said disc 117 (when the wheel and tires are revolving during movement of the vehicle).

This last-mentioned disc is provided at circumferentially spaced intervals with parallel bores thru which extend pins 126, one end of each of which normally bears lightly against the adjacent surface of the disc 111, while the opposite end of each such pin is so shaped as to comprise a pawl in engagement with ratchet teeth 127, carried in a circular row by the peripheral portion of a relatively rigid plate 128, and concentric with the shaft 112, said last-named plate being centrally secured to the central portion of a resonant diaphragm 129, which forms a closure for the otherwise open side of a cylindrical casing member 130, secured to and forming with the back-plate 94 an enclosure for the mechanism just described. As in that form of the device first described, a rocking lever 131 is suitably mounted as shown in Fig. 1, and is provided with a portion 132 which at times may be engaged by the cam-shaped end portion 133 of a radially extending shaft 134, carrying upon its outer end a lever 135, together forming a construction which is similar in construction and operation to the corresponding structure hereinbefore described in relation to Figs. 1 to 8. The opposite portion of the lever 131, as in the former case, is provided with an extension 136, provided with a rack 137 in engagement with a pinion 138, carried by the inner end of a second radially extending shaft 139, to the outer end of which is attached a drum 140, surrounded by a protecting transparent member 141, and operative by the position of suitable indicia upon its periphery to indicate the relative degree of inflation of the tires connected to the improved device, all as also hereinbefore described. This form of the device is furthermore provided with an inflating valve 142 and exhaust valve 143, as in the first instance.

In operation, this modification of the invention, upon a decrease in air pressure surrounding the bellows, as before mentioned, causes the disc 117 to cease rotating as the casing members 94 and 130 continue to rotate with the wheel to which they are connected, thereby causing the pawls to rapidly vibrate said diaphragm and effect a loud warning, designed to notify the driver of the vehicle that one of said tires has become deflated, whereupon he stops the vehicle, replaces the deflated tire, equalizes the pressures in said tires, re-sets the alarm by manually oscillating the lever 135, and re-inflates to standard pressure both tires, as hereinbefore described.

Referring finally to Figs. 14, 15 and 16, an adaptation of the invention is here shown which, instead of including a resonant diaphragm, signals information regarding the deflation of a tire directly to the vicinity of the driver of the vehicle. In this instance, a casing comprising a suitable back-plate 145 is secured in any desired manner to a wheel (not shown), represented by a concentrically arranged brake drum 146. To the forward or outer surface of said plate is secured a second casing member 147, carrying upon its inner surface a bracket 148, providing a pivotal mounting for a lever 149, one end of which is connected with one arm of a second lever 150, pivotally supported at 151 and having its opposite end in turn pivotally connected to the outer end of a shaft 152, which extends thru the bellows 153, bearing member 154, and circular flange 155, in engagement with levers 156 in cooperation with the stems 157 of ordinary pneumatic inflation type valves 158, having terminals 159, adapted to be connected to tires by means of tubes or the like, all as above described.

That end of the lever 149 opposite to the lever 150 is connected by means of a stiff wire or the like 160, extending thru a protective guide tube 161, to one end of a bell-crank lever 162 pivotally carried by the brake drum 146, and having its opposite arm connected to and operative to reciprocate a rod 163, the opposite end of which carries an anti-friction roller 164, which as the said drum rotates and said rod is in its innermost position, as a result of the contraction of the bellows (upon the deflation of a tire), depresses a cam-shaped lever 165, pivotally carried by the stationary backing plate 166, which closes the interior of the drum. Said last-named lever, which is normally maintained in outward position under tension of a spring 167, upon being intermittently depressed by said rod, closes a contact between an extension of said lever and a fixed contact point 168, carried by said backing plate. An electric current thereupon passes from a battery 169 to a bell 170 thru suitable connecting wires 171, and said backing plate thru which the circuit is completed. Thus, upon a tire becoming deflated, a warning is transmitted by means of the bell to the vicinity of the driver, or in lieu of such electric circuit, as shown in Fig. 14, an extension 172 of the lever 165 may comprise a clapper or striker for a gong 173, secured directly to said backing plate 166, said clapper-actuating lever being actuated in the same manner as hereinbefore described.

Having thus described my invention, what I claim and desire to protect by Letters Patent of the United States is:—

1. An alarm for pneumatic tires, comprising a resonant member, an actuating member, one of said members being rotatable with respect to the other, an intermediate member cooperating with said resonant member and normally stationary with respect thereto, means operative to effect inter-engagement of said intermediate member with said actuating member, to cause said intermediate member to rotate with respect

to and actuate said resonant member to produce sound, and an air conduit extending between a tire and said means, to permit air in such tire to actuate said means upon a change in pressure within the tire.

2. An alarm, comprising a normally rotating sound producing member, a relatively stationary actuating member, an intermediate member cooperating with said first member and normally stationary with respect thereto, and means operative to effect inter-engagement of said actuating member with said intermediate member, to cause said intermediate member to rotate with respect to and actuate said first member to produce sound.

3. An alarm, comprising a diaphragm having ratchet teeth, mounted upon and adapted to rotate with a wheel, a substantially stationary pendulum also carried by such wheel, a disc normally rotatable with said diaphragm and carrying a pawl engageable with said teeth, means to interlock said disc with said pendulum, and resilient means controlled by the pressure in a tire carried by said wheel, operative upon a decrease in such pressure to cause said interlocking means to operatively connect said disc to said pendulum, and cause said pawl in engagement with said teeth to vibrate said diaphragm.

4. An alarm, comprising a diaphragm having irregularities, mounted upon and adapted to rotate with a wheel, a substantially stationary gravity-actuated member also carried by said wheel, a reciprocatable disc normally rotatable with said diaphragm and carrying a reciprocatable pawl engageable with said irregularities, means to interlock said disc with said gravity-actuated member, said pawl bearing against said member and operative to be maintained thereby in engagement with said irregularities, a shaft carrying said disc, a support for said member and said shaft, and collapsible means operative to shift said shaft with respect to said member and to operate said interlocking means, as the pressure varies in a tire connected thereto.

5. An alarm, comprising a resonant member mounted upon and adapted to rotate with a vehicle wheel, a substantially stationary member also carried by such wheel, means normally rotatable with said resonant member and engageable therewith, expansible means controlled by the pressure in a tire carried by the wheel, operative upon a decrease in such pressure to permit said rotatable means to interengage said stationary member, to cause said resonant member to audibly vibrate, a casing for said stationary member, said rotatable means, and said expansible means, of which casing said resonant member forms a portion, means to operatively secure said casing to a vehicle wheel, and an air conduit connecting a tire to the interior of said casing.

6. An alarm, comprising a diaphragm having ratchet teeth, mounted upon and adapted to rotate with a wheel, a substantially stationary pendulum also carried by such wheel, a disc normally rotatable with said diaphragm and carrying a pawl engageable with said teeth, means to interlock said disc with said pendulum, and resilient means controlled by the pressure in a tire carried by said wheel, operative upon a decrease in such pressure to cause said interlocking means to operatively connect said disc to said pendulum, and cause said pawl in engagement with said teeth to vibrate said diaphragm, a casing for said pendulum, said disc, said interlocking means, and said resilient means, and formed in part by said diaphragm, means to operatively secure said casing to a vehicle wheel, and an air conduit connecting a tire with the interior of said casing.

7. The combination of a casing adapted to be secured to and rotatable with a vehicle wheel, a valve extending into an air-tight chamber within said casing, an air conduit connecting a tire upon said wheel with said valve, a resiliently positioned bellows within said chamber operative in one position to open said valve, a gravity-actuated member relative movable with respect to said casing, a resonant diaphragm rotatable with said casing, an intermediate member normally rotatable with said diaphragm and adapted to interlock with said gravity-actuated member and become rotatable with respect to said diaphragm, and means movable by said bellows upon a change of pressure within said tire and said chamber, to permit closing of said valve and shift said last-named member into locked relation with said gravity-actuated member, to cause the actuating member to audibly vibrate said diaphragm.

8. The combination of a casing adapted to be secured to and rotatable with a vehicle wheel, a valve extending into an air-tight chamber within said casing, an air conduit connecting a tire upon said wheel with said valve, a resiliently positioned bellows within said chamber operative in one position to open said valve, a gravity-actuated member relatively movable with respect to said casing, a resonant diaphragm rotatable with said casing, an intermediate member normally rotatable with said diaphragm and adapted to interlock with said gravity-actuated member and become rotatable with respect to said diaphragm, means movable by said bellows upon a change in pressure within said tire and said chamber, to permit closing of said valve and shift said last-named member into locked relation with said gravity-actuated member, to cause the actuating member to audibly vibrate said diaphragm, and means extending outside of said casing to permit the release of said actuating member from engagement with said gravity-actuated member, and the shifting of said bellows to reopen said valve.

9. The combination of a casing adapted to be secured to and rotatable with a vehicle wheel, a plurality of valves extending into an air-tight chamber within the casing, an air conduit connecting each of said valves with one of a plurality of tires upon such wheel, a resiliently positioned bellows within said chamber operative in one position to open said valves simultaneously, to permit the maintenance of equalized pressure within the tires thru said chamber, a gravity-actuated member relatively movable with respect to said casing, a resonant diaphragm rotatable with said casing, an intermediate member normally rotatable with said diaphragm and capable of moving into inter-engagement with said gravity-actuated member, so as to become rotatable with respect to said diaphragm, and means movable with said bellows upon a change of pressure within one on said tires and said chamber, to permit closing of said valves and prevent the deflation of the other tire, and to shift said actuating member into inter-engagement with said gravity-actuated member, to cause the latter to audibly vibrate said diaphragm, and means for adjusting the resiliency with which said bellows is positioned, to accommodate its operation to tires of different operating pressures.

10. The combination of a casing adapted to be secured to and rotatable with a vehicle wheel, a plurality of valves extending into an air-tight chamber within said casing, an air-conduit connecting each of said valves with one of a plurality of tires upon such wheel, a resiliently positioned bellows within said chamber operative in one position to open said valves simultaneously, to permit the maintenance of equalized pressure within the tires thru said chamber, a gravity-actuated member relatively movable with respect to said casing, a resonant diaphragm rotatable with said casing, an intermediate member normally rotatable with said diaphragm and capable of moving into inter-engagement with said last-named member, so as to become rotatable with respect to said diaphragm, and means movable with said bellows upon a change of pressure within one of said tires and said chamber, to permit closing of said valves and prevent the deflation of the other tire, and to shift said actuating member into inter-engagement with said gravity-actuated member, to cause the latter to audibly vibrate said diaphragm, and visual means movable in accordance with the reciprocation of said actuating member, to indicate the relative degree of inflation of the tires when inter-connected, and of either tire when deflated.

11. The combination of a casing adapted to be secured to and rotatable with a vehicle wheel, a plurality of valves extending into an air-tight chamber within said casing, an air conduit connecting each of said valves to one of a plurality of tires upon such wheel, a resiliently positioned bellows within said casing chamber operative in one position to open said valves simultaneously, to permit the maintenance of equalized pressure within the tires thru said chamber, a gravity-actuated member relatively movable with respect to said casing, a resonant diaphragm rotatable with said casing, an intermediate member normally rotatable with said diaphragm and capable of moving into inter-engagement with said last-named member, so as to become rotatable with respect to the diaphragm, means movable with said bellows upon a change of pressure within one of said tires and said chamber, to permit closing of said valves and prevent the deflation of the other tire, and to shift said actuating member into inter-engagement with said gravity-actuated member, to cause the latter to audibly vibrate said diaphragm, and means accessible from the outside of said casing to release said actuating member from said gravity-actuated member and to re-open said valves, and permit the increase of pressure within said chamber to maintain said bellows in normal position, said valves open, and said last-mentioned members in released relation.

12. An alarm, comprising a resonant member having irregularities, mounted upon and adapted to rotate with a vehicle wheel, a substantially stationary gravity-actuated member also carried by said wheel, a disc normally rotatable with said resonant member and having movably mounted members engageable with said irregularities, means for interlocking said disc with said stationary member, and expansible means controlled by the pressure in a tire carried by the wheel, operative upon a decrease in such pressure to permit said interlocking means to secure said disc to said stationary member, to cause said movably mounted members in engagement with said irregularities to vibrate said resonant member.

13. The combination of a casing adapted to be secured to a vehicle wheel provided with a plurality of tires, a pneumatically actuatable alarm within said casing, an air-tight chamber within said casing, means extending into said chamber to actuate said alarm, an opening leading into said chamber, separate valves leading into said chamber and connected by conduits with a plurality of tires carried by the vehicle wheel to which the casing is attached, air conduits connecting said first conduits together and to said opening, and valves in said last-named conduits, between said separate valves and said opening.

14. An alarm, comprising a resonant member mounted upon and adapted to rotate with a vehicle wheel, a substantially stationary member attached to the axle of such wheel, means normally rotatable with said resonant member and engageable therewith, and expansible means controlled by the pressure in a tire carried by the wheel, operative upon a decrease in such pressure to permit said rotatable means to inter-engage said stationary member, to cause said resonant member to audibly vibrate.

15. An alarm, comprising a resonant member mounted upon and adapted to rotate with a vehicle wheel, a substantially stationary member attached to the axle of such wheel, means normally rotatable with said resonant member and engageable therewith, expansible means controlled by the pressure in a tire carried by the wheel, operative upon a decrease in such pressure to permit said rotatable means to inter-engage said stationary member, to cause said resonant member to audibly vibrate, a casing for said stationary member, said rotatable means, and said expansible means, of which casing said resonant member forms a portion, means to secure said casing to a vehicle wheel, a valve extending into said casing, an air conduit connecting a tire upon the wheel to said valve, and means accessible from the outside of said casing to release said rotatable means from inter-engagement with said stationary member and to open said valve, and permit the increase of pressure within said chamber from the tire to maintain said expansible means in normal position, said valve open, and said inter-engaging members in released relation.

16. An alarm, comprising an audible means, actuating means for said first means carried by a vehicle, a casing carried by and rotatable with a wheel of such vehicle, a valve leading into said casing, an air conduit connecting a tire upon such wheel with said valve, expansible means in said casing and operative in one position to maintain said valve open, and power transmitting means actuated by said expansible means to cause said actuating means to operate said audible means upon a decrease in the air pressure within the tire.

17. The combination of a vehicle wheel carrying a pneumatic tire normally resting upon a supporting surface, with an alarm, comprising a sound producing element, a gravity actuated member relatively movable with respect to the wheel when rotating, and at all times free and independent of such tire-supporting surface and means operative upon a change in pressure in the tire to cause said member to sound the alarm.

18. The combination of a vehicle wheel carrying a pneumatic tire normally resting upon a supporting surface, with a sound producing element, a gravity actuated member at all times free to rotate with respect to said wheel and tire and

independently of such tire-supporting surface, and means operative upon a change in pressure in the tire to cause said member to operate said element.

19. The combination of a wheel carrying a pneumatic tire normally resting upon a supporting surface, with an alarm, in turn comprising a gravity actuated member at all times free to rotate with respect to said wheel and tire and independently of such tire-supporting surface, and a sound producing device adapted to be operated by said member upon a change in the pressure within the tire.

20. The combination of a shaft, a wheel rotatably mounted thereon and a pneumatic tire in turn mounted upon said wheel, a gravity actuated pendulum also supported by said shaft, an audible alarm, and pneumatically actuated means operative upon a change in pressure in the tire, to cause said pendulum to operate said alarm.

21. The combination with a vehicle wheel and its pneumatic tire, of a normally inoperative audible alarm, comprising parts producing sound upon relative movement therebetween but normally rotating with the wheel, means non-rotative with the wheel, and means operative upon a change in tire pressure to connect one of said parts with the non-rotative means, whereby to produce said relative sound producing movement.

22. The combination with a vehicle wheel and its pneumatic tire, of a normally inoperative alarm comprising parts producing an alarm upon relative movement thereof but normally rotating together and with the wheel, means non-rotative with the wheel, and means operating upon a change in tire pressure to connect one of said parts with the non-rotative means, whereby to produce said relative alarm producing movement.

23. The combination with a wheel with dual pneumatic tires, of a pressure equalizer means operating to shut off a given tire after a predetermined drop in pressure produced therein by a drop in the pressure of the other tire, an audible alarm device carried by the wheel, and adjustable means operative to permit the operation of said alarm either during or after said predetermined drop in pressure.

24. The combination of a vehicle wheel and its pneumatic tire with an audible alarm comprising a casing unitarily attached to said wheel, and rotatable therewith, a gravity-actuated member within said casing, means to operatively connect the interior of said casing with said tire, and means actuated upon a decrease in the pressure within said tire below a predetermined degree to cause said gravity-actuated means to sound said alarm.

25. The combination of a vehicle wheel with its plurality of pneumatically inflated tires, an audible alarm comprising a casing forming a unitary part of said wheel and rotatable therewith, a gravity-actuated member carried by said casing, means to operatively connect the interior of said casing with each of said tires, and means actuated upon a decrease in the pressure within one of said tires below a predetermined degree to cause said gravity-actuated means to actuate said alarm.

26. The combination of a vehicle wheel with its plurality of pneumatically inflated tires, a casing unitarily attached to said wheel and rotatable therewith, an audible alarm comprising a part of said casing, a gravity-actuated member carried by said casing, means operative to connect the interior of said casing with each of said tires, and means actuated by a decrease in the pressure within one of said tires below a predetermined degree to cause said gravity-actuated means to actuate said alarm.

27. The combination of a wheel and its pneumatic tire, a normally inoperative sound producing element, a non-rotating gravity actuated member carried by and rotatable with relation to said wheel when said wheel is itself rotated, and means whereby said member while hanging freely suspended causes said element to produce sound, when the pressure within said tire falls below a pre-determined degree.

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