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Smith

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[54] **VEHICLE SUSPENSION DEVICE**

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Related U.S. Patent Documents

Reissue of:

[64] Patent No.: **3,346,272**
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Filed: **Oct. 14, 1965**

U.S. Applications:

[63] Continuation of Ser. No. 735,809, Oct. 26, 1976, abandoned.

[51] **Int. Cl.**[3] **B60G 11/14**

[52] **U.S. Cl.** **280/668**

[58] **Field of Search** ..... 280/660, 666–668, 280/670, 672, 674, 693, 696; 267/8 R, 34, 6.4 R; 188/321

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,567,144	9/1951	Butterfield	280/670
2,624,592	1/1953	MacPherson	280/668
2,935,334	5/1960	Felts	280/666
2,992,013	7/1961	Seigler	280/670
3,156,481	11/1964	Dangauthier	280/668

FOREIGN PATENT DOCUMENTS

595193	6/1959	Italy	280/668
1031650	6/1966	United Kingdom .	

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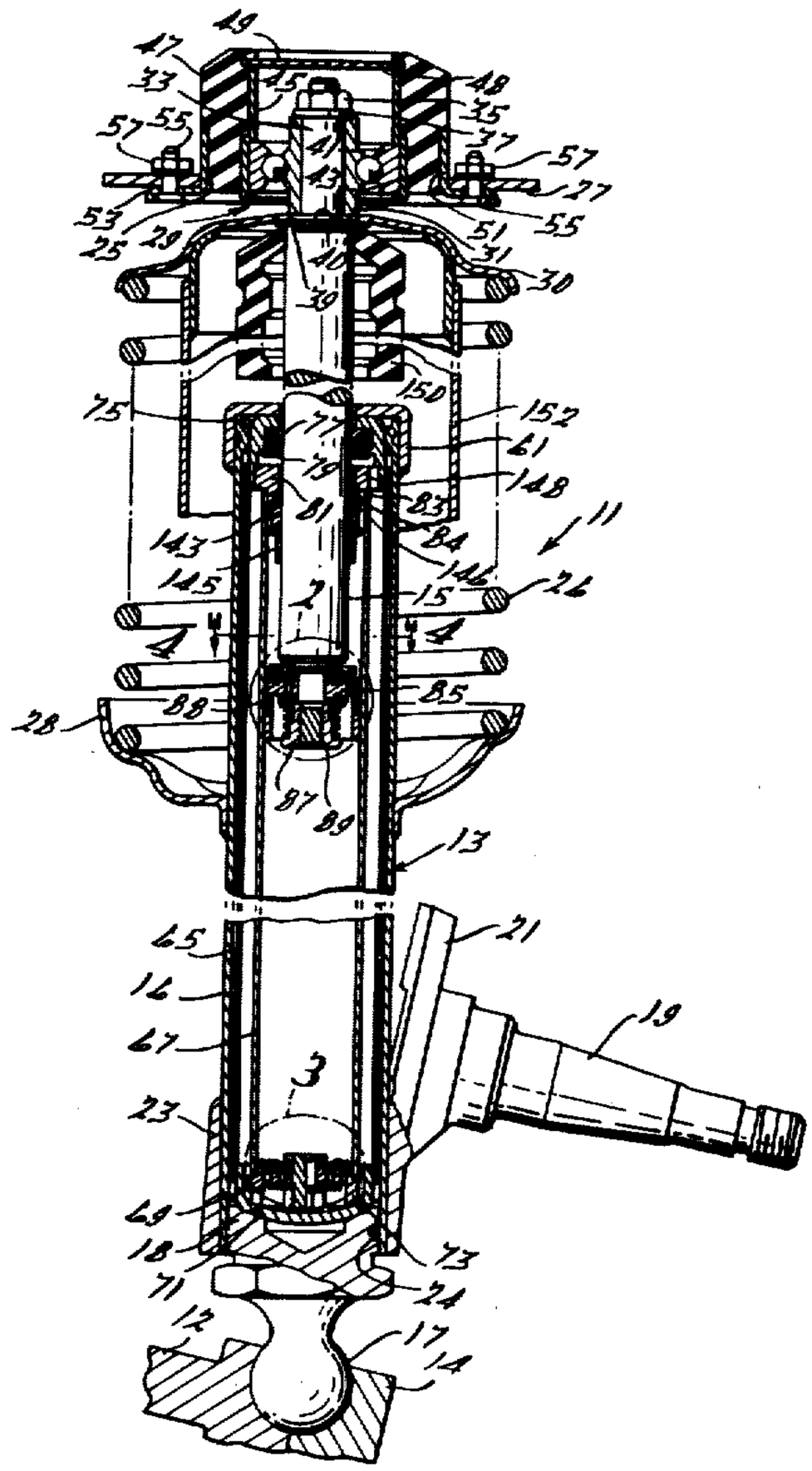
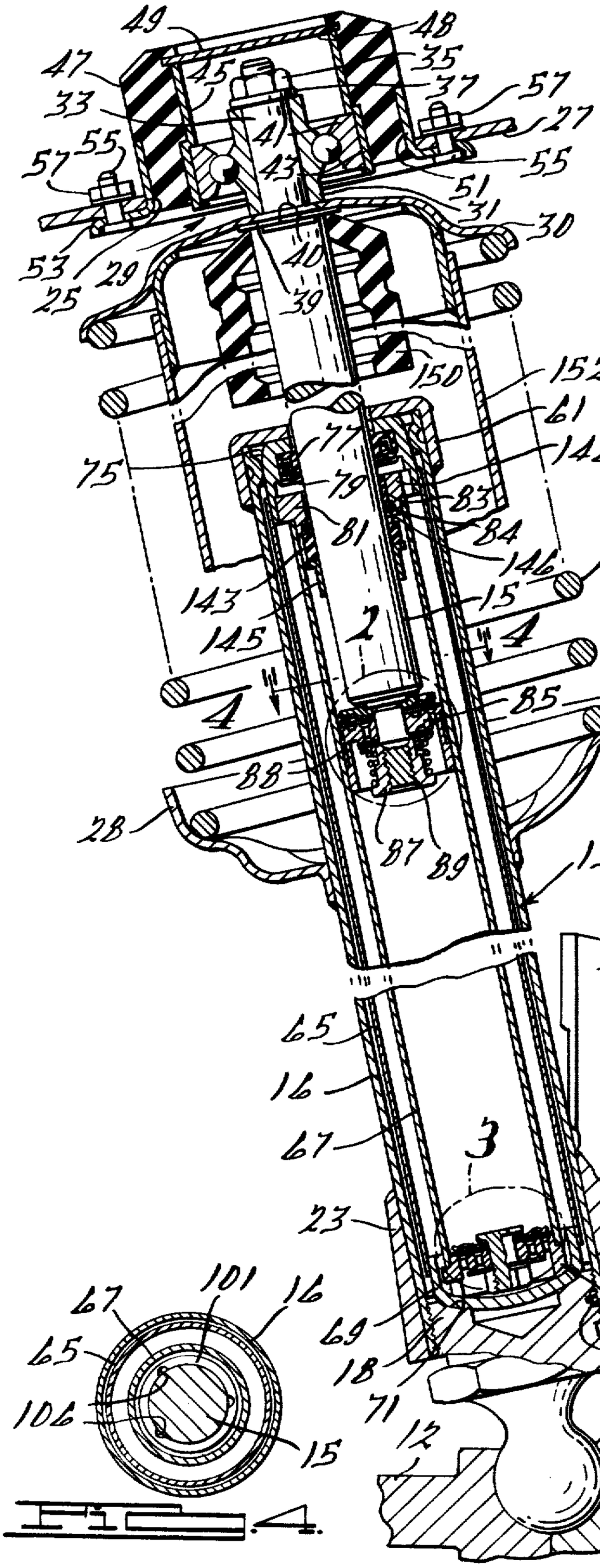
[57] **ABSTRACT**

A vehicle coil spring and shock absorber connected directly to the front wheel by a mounting tube having a removable bottom through which the shock absorber may be removed.

38 Claims, 4 Drawing Figures





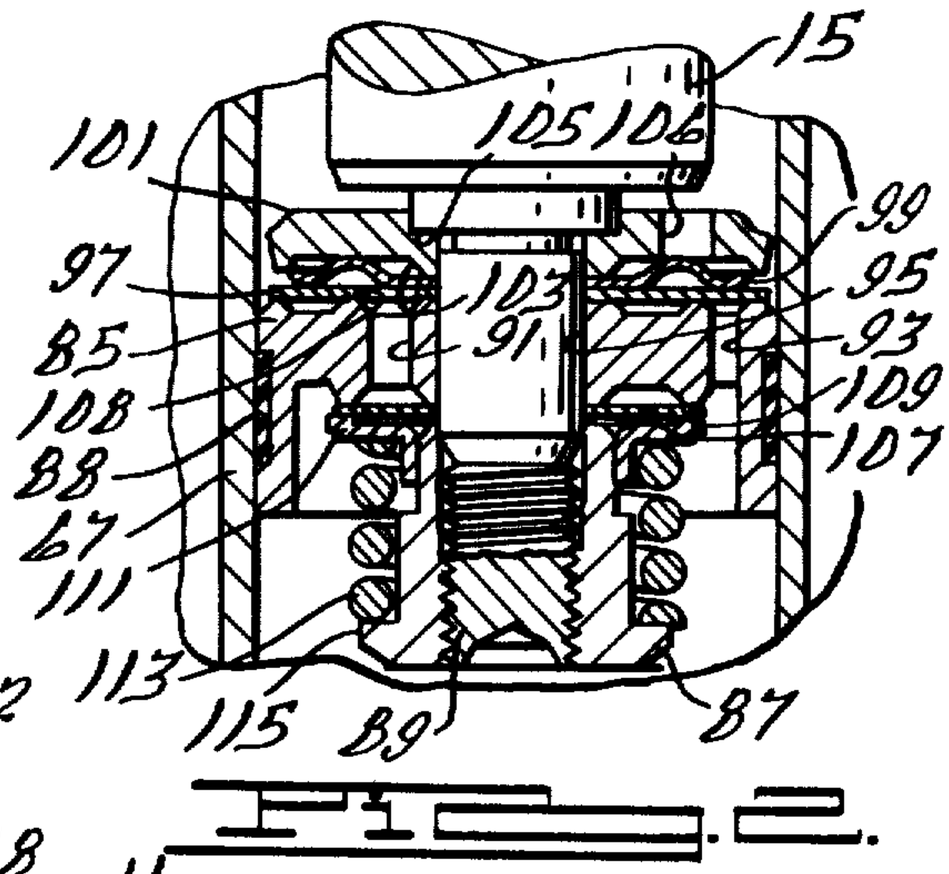


FIG. 2.

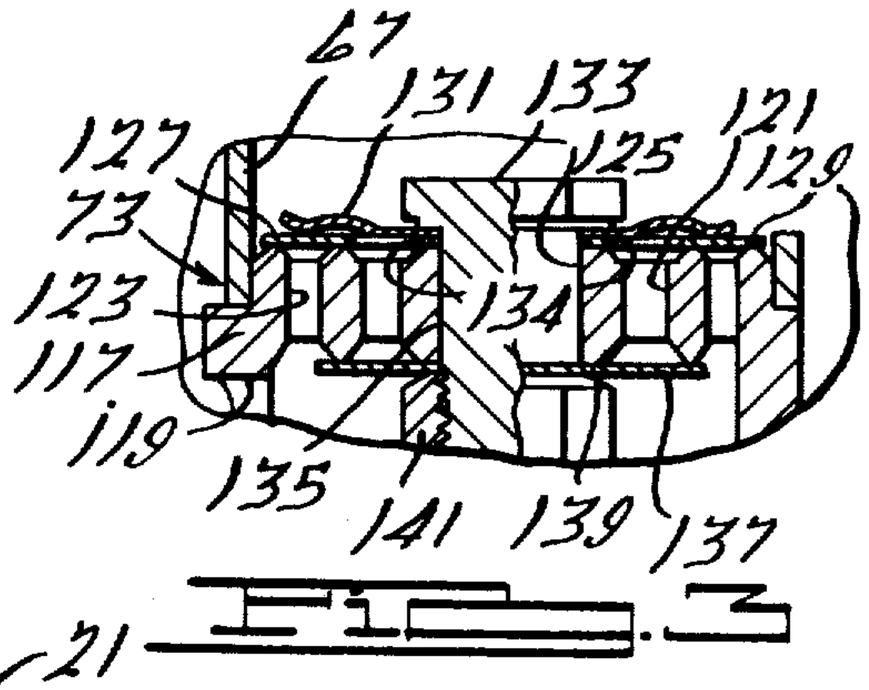


FIG. 3.

FIG. 1.

FIG. 4.

VEHICLE SUSPENSION DEVICE

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

This application is a continuation of U.S. application Ser. No. 5,735,809 filed Oct. 26, 1976, now abandoned, which is a Reissue application of Ser. No. 5,496,045 filed Oct. 14, 1965, Pat. No. 3,346,272.

This invention relates generally to motor vehicles, and particularly to an improved suspension device flexibly supporting the vehicle chassis upon ground contacting wheels.

In some motor vehicle suspension systems, it is desirable to locate the suspension devices which together make up the front suspension system and which devices each include a coil spring and shock absorber, directly at each vehicle front wheel. One such suspension system is illustrated and described in the U.S. Pat. No. 2,624,592 to MacPherson and is referred to in the trade as the MacPherson system.

One of the undesirable aspects of this type of suspension system, has been that in the past it has been necessary to dismantle a major portion of the vehicle front end, including each wheel and wheel spindle when removing and replacing the shock absorbers after their parts become worn. This is a costly, difficult and time consuming process and requires special tools and skills. Therefore, a suspension device incorporating the desirable features of the MacPherson system but which eliminates the complex dismantling and replacement aspects for the shock absorber would be highly desirable.

Main obects of the present invention are an improved vehicle suspension device including a coil spring and shock absorber which supports the vehicle chassis directly at each wheel and which permits the shock absorber to be removed and replaced in installation *as a cartridge unit* with a minimum of difficulty and without disturbing or dismantling other vehicle components.

Further objects include an improved suspension device of the above character which is relatively inexpensive to manufacture, rugged in construction and reliable in use.

Other objects and advantages of the present invention will become more apparent from a consideration of the following detailed description taken in conjunction with the drawings in which:

FIG. **1** is a sectional view of a suspension device embodying the present invention;

FIG. **2** is an enlarged view of a portion of the structure of FIG. **1** taken within the circle **2**;

FIG. **3** is an enlarged view of a portion of the structure of FIG. **1** taken within the enclosure **3**; and

FIG. **4** is a sectional view of FIG. **1** taken along the line **4—4** thereof.

Broadly described, the present invention includes an automotive vehicle suspension device having a telescopic type, shock absorber and a surrounding coil spring wherein the shock absorber has one end detachably connectable to the vehicle body or frame and the other end removably supported within a tube connectable to the vehicle wheel spindle so that the shock absorber is removable *as a cartridge unit* upon detaching from the vehicle body or frame without disturbing the wheel or wheel spindle.

Referring now more specifically to the drawings and particularly FIG. **1**, a suspension device embodying the present invention is illustrated generally at **11** and is seen to include a cylinder assembly **13** comprising a plurality of concentric tubes in which a piston rod **15** is slidably disposed in telescopic fashion, the cylinder assembly **13** and piston rod together forming a vehicle shock absorber. The cylinder assembly **13** is removably supported in a tube **16** secured at its lower end to a wishbone suspension member **12** through a ball **17** universally received in a detachable socket **14**, the ball **17** having an integral threaded upper end **18** threadedly received in the tube **16**. A wheel spindle **19** upon which the vehicle wheel (not shown) is mounted has a sleeve **23** encompassing and secured to the lower end of the tube **16**. A removable locking pin **24** extends through aligned openings in the tube **16**, the threaded end **18** and the sleeve **23** to prevent the ball **17** from the inadverently detaching from the tube **16** during use.

The piston rod **15** extends upwardly through an opening **25** in the body or frame of the vehicle, a portion of which is shown at **27**. A ball bearing **29** has an elongated inner race **31** held on a reduced end **33** of the piston rod **15** by a nut **35** and washer **37**. The lower end of the bearing inner race **31** engages a washer **39** seated against a shoulder **40** on the piston rod **15**. The outer race **41** of the bearing **29** is seated in an enlarged end **43** of a tubular member **45** secured in sleeve **47** which may be constructed of flexible rubber or rubber-like material. The enlarged end **43** of the tubular member **45** is crimped below the outer bearing race **41** to hold the bearing **29** in place. A disc **49** is removably positioned in a groove **48** in the upper end of the sleeve **47** to keep dirt, grease and other foreign matter from accumulating above and contaminating the bearing **29**. The sleeve **47** is secured to the vehicle body **27** by an annular collar **51** surrounding and secured to the sleeve **47** and formed with an integral radially outwardly extending flange **53** overlying the vehicle body **27** and secured thereto by bolts **55** and nuts **57**.

In use, the shock absorber piston rod **15** moves with the vehicle body or frame **27** and slides telescopically within the cylinder assembly **13**, the flexible sleeve **47** allowing angular displacement between the piston rod **15** and the body or frame **27** and the ball bearing **29** allowing the piston rod to turn therewithin. The tube **16** which houses the cylinder assembly **13** is supported upon the wishbone suspension number **12** through the ball **17** and turns with the wheel (not shown) and the spindle **19** substantially about the longitudinal central axis of the tube **16** and cylinder assembly **13**.

The vehicle chassis weight is supported by the wheels and is suspended at each wheel by a coil spring **26** sleeved over the tube **16**. The lower end of the spring **26** is seated in an annular spring support **28** welded or otherwise secured to the tube **16** and the spring upper end is seated in a hat-shaped annular support **30** seated between the bearing inner race **31** and the washer **39**. Thus, when the vehicle body or frame **27** moves downwardly relative to the wheels (not shown), the piston rod **15** moves downwardly within the cylinder assembly **13** and the spring **26** is compressed. Upward movement of the vehicle body or frame **27**, of course, causes upward movement of the piston rod **15** and allows the spring **26** to expand.

To cushion and dampen this relative movement between the vehicle body and frame **27** and the wheels and creating the desired shock-absorbing characteris-

tics, the piston rod **15** and cylinder assembly **13** are provided with valve means shown in FIG. **1** and in greater detail in FIGS. **2** and **3**. Thus, the cylinder assembly **13** includes an outer or reserve tube **65** having its lower end closed by a cap or closure **69** which is seated in a recess **71** in the threaded end **18** of the ball **17**. A pressure cylinder **67** is positioned within the reserve tube **65** and has a valve assembly **73** fitted in and closing the lower end thereof, the valve assembly **73** being seated in the cap **69**.

The upper end of hte reserve tube **65** has a cap **75** fitted therein and seated against a cap **61** welded to the tube **16**. A seal assembly **77** is held in the cap **75** by a retaining ring **79** and engages the piston rod **15** to prevent the loss of fluid pressure therepast. The lower end of the cap **75** positions an annular piston rod guide **81** which surrounds and **[**guides**]** *acts as a guide means for the upper end of* the piston rod **15** **[**and has its lower end**]** *, the lower end of the guide 81 being* fitted in the upper end of the pressure tube **67**. An absorbent and resilient annular sleeve **83** held in the rod guide **81** by a snap ring **84** engages the piston rod **15** and prevents it from becoming scored during movement relative to the guide **81**.

A piston **85** is retained on a reduced and threaded lower end **89** of the piston rod **15** by a nut **87** and has a piston ring **88** engaging the wall of the pressure cylinder **67** to prevent the flow of fluid therepast. The piston **85** *along with the interior of the cylinder 67 within which it is slidably disposed, acts as a guide means for the lower end of the piston rod 15. The piston 85* is provided with an inner set of circumferentially spaced passages **91** and an outer set of circumferentially spaced passages **93** and has a central aperture **95** through which the reduced and threaded lower end **89** of the piston rod **15** extends (FIG. **2**). The upper ends of the passages **93** are closed by a disc **97** yieldably held in engagement with a valve seat **98** on the top of the piston **85** by a finger-type spring **99**. A support washer **101** has an annular flange **103** engaging and holding the inner peripheral portion of the spring **99** against the piston **85**. The washer **101**, in turn, is disposed between the top of the piston **85** and a radial shoulder **105** on the piston rod **15**. The washer **101** also has one or more apertures **106** which communicate with apertures **108** in the disc **97** and with the upper ends of the inner passages **91**. The lower ends of the inner passages **91** are closed by a valve disc **107** yieldably held in engagement with a valve seat **109** on the lower surface of the piston **85** by a cage **111** against which one end of a compression spring **113** acts, the other end of the compression spring engaging a flange **115** on the nut **87**.

The valve assembly **73** at the lower end of the pressure tube **67** is shown in greater detail in FIG. **3** and includes a valve body **117** having grooves **119** in its underside which communicate the space beneath the valve body **117** with the space between the pressure cylinder **67** and the reserve tube **65**, so that hydraulic fluid can flow from the pressure cylinder to the reserve tube and vice versa. The valve body **117** has an inner set of circumferentially spaced passages **121** and an outer set of circumferentially spaced passages **123** and a large central aperture **125**. The upper ends of the passages **123** are closed by a valve disc **127** yieldably held in engagement with a valve seat **129** on the top surface of the valve body **117** by a fingertype spring **131**. The inner circumference of the spring **131** and the valve disc **127** are held against the valve seat **129** by a head **133** formed

on a nut or plug **135** extending through the aperture **125**. The valve disc **127** has one or more apertures **134** which communicate with the upper ends of the aperture **121**. The lower ends of the apertures **121** are closed by a valve disc **137**, the inner circumferential portion of which is held in engagement with a valve seat **139** on the lower surface of the valve body **117** by a nut **141** threaded on the lower end of the plug **135**.

In use, the vehicle body weight is supported by the wheels and is suspended at each wheel by the coil spring **26** as described above. When the vehicle body moves upwardly relative to the wheel causing the piston **85** to move upwardly relative to the cylinder assembly **13** on the rebound stroke, the pressure of the hydraulic fluid in the pressure cylinder **67** above the piston increases until the valve disc **107** moves away from the valve seat **109** and the fluid flows through the inner piston passages **91** into the lower portion of the pressure cylinder **67**. The fluid pressure at which the valve disc **107** moves away from the seat **109** is a function of the stiffness of the spring **113** and that of the disc **107**. Because the piston rod **15** occupies a portion of the pressure cylinder **67** above the piston **85**, it is necessary that the lower portion of the pressure cylinder be replenished with fluid during the rebound stroke. This is achieved by the flow of liquid from the reserve tube **65** through the apertures **119** in the valve body **117** and upwardly through the outer passages **123**. As the valve plate **127** is held on its seat only by the light spring **131**, the differential pressure on opposite sides of the valve plate **127** is sufficient to move the valve plate away from its seat **129** so that the pressure cylinder remains filled with fluid. Upward movement of the piston rod **15** is limited and cushioned by a resilient annular sleeve **143** engageable with the lower end of the guide **81** and held in place on the piston rod **15** by a collar **145**. The sleeve **143** has one or more radial slots **146** at its upper end and the sleeve **143** and collar **145** are spaced from the wall of the pressure cylinder **67** permitting fluid within the pressure cylinder to maintain the absorbent sleeve **83** saturated.

When the piston **85** moves downwardly in the pressure cylinder **67** on the compression stroke, fluid in the pressure cylinder below the piston flows upwardly through the outer piston passages **93** when sufficient pressure has been built up below the piston **85** to overcome the force of the spring **99** and move the valve disc **97** away from its seat **108**. The pressure cylinder **67** above the piston **85** cannot accommodate all of the fluid displaced from the lower portion of the pressure cylinder because of the presence of the piston rod **15**. Therefore, as the piston **85** moves downwardly in the pressure cylinder **67**, fluid pressure builds up below the piston **85** and moves the valve disc **137** away from the valve seat **139** by flexing the disc thereby allowing fluid to flow from the lower portion of the pressure cylinder **67** through the apertures **119** in the valve body **117** and out to the reserve cylinder **65**. One or more passageways **148** in the piston rod guide **81** permit fluid in the reserve cylinder **65** to maintain the top of the absorbent sleeve **83** saturated. Downward travel of the piston rod **15** is cushioned and limited by a resilient sleeve **150** fixed to the piston rod **15** and engageable with the top of the cap **61**. A skirt **152** is seated against the spring support **30** and surrounds the sleeve **150** and the top of the tube **16** to prevent dirt, grease and other foreign matter from getting on the piston rod **15**.

The resistance of the suspension device to compression and rebound movement is established by the size of the passageways and the stiffness of the valve discs and the loading springs so as to attain the desired operating conditions and provide smooth and comfortable riding qualities.

As described above, a major problem which has existed in suspension systems of this type has been that when the shock absorber components become worn and require replacement, a major portion the vehicle front end and steering controls had to be dismantled. This was so because in these prior systems, the cylinder assembly **13** was connected directly to the spindle **19** and to the ball **17** of the ball socket joint. This problem has been eliminated by the present invention by providing the tube **16** which here is secured to the spindle **19** and to the ball **17** as illustrated and described making the entire shock-absorber assembly easily removable. Thus, when the shock-absorber components, including the piston **85**, the pressure cylinder **67** and the valves become worn and require replacing, it is only necessary to remove the nut **35** from the upper reduced end **33** of the piston rod **15** after snapping the plate **49** out of the sleeve **47** and to unscrew the ball member **17** from within the tube **16** after removing the pin **24**. The entire shock-absorber assembly including the reserve tube **65**, the pressure tube **67** and the piston rod **15** can then be slid out of the tube **16** through its lower end. During this time, the bearing **29** and the washer **39** hold the spring support **30** in place so that the spring **26** remains intact. Thereafter, a new shock-absorber assembly is inserted, the ball member **17** threaded into the lower end of the tube **16** and the nut **35** threaded on the upper reduced end **33** of the new piston rod **15**. In this way, the old shock absorber is quickly and easily removed and replaced with a new one without requiring costly, difficult and time-consuming dismantling of the vehicle front end or steering controls.

Thus, by the present invention there has been provided an improved suspension device having an easily replaceable shock-absorber assembly constructed to fulfill the objects hereinabove set forth, and while a preferred embodiment has been illustrated and described above in detail, various additions, substitutions, modifications and omissions may be made thereto without departing from the spirit of the invention as encompassed by the appended claims.

What is claimed is:

1. In an independent wheel suspension device for an automotive vehicle, said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts, detachable means on one of said telescopic parts connectable to a body portion of said vehicle, a tube removably supporting the other of said telescopic parts, said tube being connectable to a wheel spindle and having a removable end portion whereby said shock absorber is removable and replaceable through the end of said tube having said removable end portion upon detaching said detachable means.

2. In an independent wheel suspension device for an automotive vehicle, said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts, detachable means on one of said telescopic parts connectable to a body portion of sadi vehicle, a tube removably supporting the other of said telescopic parts, said tube being connectable to a wheel spindle and having a threaded member forming a closure for one end thereof connectable to and supportable by a suspension arm, whereby said shock absorber is removable and replaceable through said one end upon detaching said detachable means and removing said threaded member.

3. In an independent wheel suspension device for an automotive vehicle, said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts, detachable means on one of said telescopic parts connectable to a body portion of said vehicle, a tube removably supporting the other of said telescopic parts, a compression spring sleeved over said tube, said spring caged between a first support fixed to said tube and a second support supportable by said body portion, said tube being connectable to a wheel spindle and having a threaded member in one end thereof, universally supportable on a suspension arm, whereby said shock absorber is removable and replaceable upon detaching said detachable means and removing said threaded member.

4. In an independent wheel suspension device for an automotive vehicle, said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts, detachable means on one of said telescopic parts connectable to a body portion of said vehicle, a tube connectable to a wheel spindle and removably receiving the other of said telescopic parts, said tube having a ball member threaded into its lower end, said ball member supporting the other of said telescopic parts and receivable in a socket connectable to a suspension arm whereby said shock absorber is removable and replaceable upon detaching said detachable means and removing said ball member from said tube lower end.

5. In an independent wheel suspension device for an automotive vehicle, said suspension device comprising a hydraulic tubular shock absorber having a piston rod and piston slidably disposed in a cylinder assembly, detachable means on said piston rod connectable to a body portion of said vehicle, said detachable means including a bearing supportable in said body portion and receiving a reduced end of said piston rod and a nut threaded on said reduced end, a tube connectable to a wheel spindle and removably receiving said cylinder assembly, said tube having a ball member threaded into its lower end, said ball member supporting said cylinder assembly and receivable in a socket connectable to a suspension arm whereby said shock absorber is removable and replaceable upon detaching said nut and removing said ball member from said tube lower end.

6. In an independent wheel suspension device for an automotive vehicle, said suspension device comprising a hydraulic tubular shock absorber having a piston rod and piston slidably disposed in a cylinder assembly, detachable means on said piston rod connectable to a body portion of said vehicle, said detachable means including a bearing resiliently supportable in said body portion and receivng a reduced end of said piston rod and a nut thread on said reduced end, a tube connectable to a wheel spindle and removably receiving said cylinder assembly, a compression spring sleeved over said tube, said spring caged between a first support fixed to said tube and a second support held between said bearing and a shoulder on said piston rod adjacent said reduced end, said tube having a ball member threaded into its lower end, said ball member supporting said cylinder assembly and receivable in a socket connectable to a suspension whereby said shock absorber is

removable and replaceable upon detaching said nut and removing said ball member from said tube lower end.

7. In an independent wheel suspension device for an automotive vehicle, said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts, detachable means on one of said telescopic parts connectable to a body portion of said vehicle, a tube mounted in and fixed to a sleeve connectable to a wheel spindle and removably receiving the other of said telescopic parts, said tube having a ball member threaded into its lower end, said ball member supporting the other of said telescopic parts and receivable in a socket connectable to a suspension arm whereby said shock absorber is removable and replaceable upon detaching said detachable means and removing said ball member from said tube lower end.

8. In a MacPherson-type independent wheel suspension device for an automotive vehicle having sprung and unsprung portions,

said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts,

detachable means on one of said telescopic parts connectable to a body portion of said vehicle,

a tube removably supporting the other of said telescopic parts,

said tube having a wheel spindle mounted thereon and having an opening in one end thereof through which said shock absorber is removable and replaceable, said tube being provided with a removable end member which when mounted on said tube retains said shock absorber therein, and when removed, permits removal of said shock absorber upon detaching said detachable means.

9. In a MacPherson-type independent wheel suspension device for an automotive vehicle having sprung and unsprung portions,

said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts,

one of said parts comprising a cylinder and the other of said parts comprising a piston and piston rod reciprocably disposed in said cylinder, with said piston rod extending longitudinally from one end of said cylinder,

detachable means on said one telescopic part comprising said piston rod connectable to the sprung body portion of said vehicle,

a tube removably supporting said cylinder,

said tube being connectable to a wheel spindle and having a removable end portion wherein said shock absorber is removable and replaceable as a cartridge unit through the end of said tube having said removable end portion upon detaching said detachable means.

one of said parts comprising a cylinder and the other of said parts comprising a piston and piston rod reciprocably disposed in said cylinder, with said piston rod extending longitudinally from one end of said cylinder,

said piston rod being connected to said sprung portion of the vehicle,

detachable means on said one telescopic part comprising said piston rod connectable to the sprung body portion of said vehicle so as to provide for relative rotational movement between said piston rod and said sprung body portion,

a tube removably supporting said cylinder,

said tube having a wheel spindle fixedly secured adjacent the lower end thereof and having a removable end portion said shock absorber is removable and replaceable as a cartridge unit through the end of said tube having said removable end portion upon detaching said detachable means.

10. The invention as set forth in claim 9 wherein the longitudinal axis of said device defines a pivotal axis about which a wheel mounted on said spindle is pivotable during steering movement thereof, first and second guide means located at longitudinally spaced apart positions along said pivotal axis for guiding said first and second parts for longitudinal sliding movement.

11. The invention as set forth in claim 10 wherein said first and second guide means comprise said piston and cylinder, and said piston rod and a rod guide assembly located adjacent the upper end of said cylinder.

12. The invention as set forth in claim 9 which includes a coil spring extending around the upper end of said device and supported at one end by a first spring support located on said tube and at the opposite end thereof by a second spring support located adjacent the connection of said piston rod with said sprung vehicle portion.

13. The invention as set forth in claim 9 wherein the longitudinal axis of said device defines a pivotal axis about which a wheel mounted on said spindle is pivotable during steering movement thereof, first and second guide means located at longitudinally spaced apart positions along said pivotal axis for guiding said first and second parts for longitudinal sliding movement, and a coil spring extending around said device and supported at one end by a first spring support located on said tube and at the opposite end thereof by a second spring support located adjacent the connection of said piston rod with said sprung vehicle portion.

14. The invention as set forth in claim 13 wherein said coil spring is arranged coaxially of said suspension strut.

15. The invention as set forth in claim 9 wherein said piston rod is rotatably connected to said sprung vehicle portion.

16. In a MacPherson-type independent wheel suspension device for an automotive vehicle having sprung and unsprung portions,

said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts,

one of said parts comprising a cylinder and the other of said parts comprising a piston and piston rod reciprocably disposed in said cylinder, with said piston rod extending longitudinally from one end of said cylinder,

said piston rod being directly connected to said sprung portion of the vehicle,

detachable means on said one telescopic part comprising said piston rod connectable to the sprung body portion of said vehicle,

the longitudinal axis of said device defining a pivotal axis about which a wheel mounted on a wheel spindle is pivotable during steering movement thereof, first and second guide means located at longitudinally spaced apart positions along said pivotal axis for guiding said first and second parts for longitudinal sliding movement,

a tube removably supporting said cylinder,

said tube being connectable to a wheel spindle and having a removable end portion wherein said shock absorber is removable and replaceable as a cartridge unit

through the end of said tube having said removable end portion upon detaching said detachable means.

17. In a MacPherson-type independent wheel suspension device for an automotive vehicle having sprung and unsprung portions,

said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts,

one of said parts comprising a cylinder and the other of said parts comprising a piston and piston rod reciprocably disposed in said cylinder, with said piston rod extending longitudinally from one end of said cylinder,

said piston rod being connected to said sprung portion of the vehicle,

detachable means on said one telescopic part comprising said piston rod connectable to the sprung body portion of said vehicle,

a tube removably supporting said cylinder,

a coil spring extending around said device and supported at one end by a first spring support located on said tube and at the opposite end thereof by a second spring support located adjacent the connection of said piston rod with said sprung vehicle portion,

said tube being connectable to a wheel spindle and having a removable end portion wherein said shock absorber is removable and replaceable as a cartridge unit through the end of said tube having said removable end portion upon detaching said detachable means.

18. The invention as set forth in claim 17 wherein said first and second guide means comprise said piston and cylinder, and said piston rod and a rod guide assembly located adjacent the upper end of said cylinder.

19. In a MacPherson-type independent wheel suspension device for an automotive vehicle having sprung and unsprung portions,

said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts,

one of said parts comprising a cylinder and the other of said parts comprising a piston and piston rod reciprocably disposed in said cylinder, with said piston rod extending longitudinally from one end of said cylinder,

said piston rod being connected to said sprung portion of the vehicle,

detachable means on said one telescopic part comprising said piston rod connectable to the sprung body portion of said vehicle so as to provide for relative rotational movement between said piston rod and said sprung body portion,

a tube removably supporting said cylinder,

said tube having a wheel spindle fixedly secured adjacent the lower end thereof and having a removable end portion wherein said shock absorber is removable and replaceable as a cartridge unit through the end of said tube having said removable end portion upon detaching said detachable means.

20. The invention as set forth in claim 19 wherein said coil spring is arranged coaxially of said suspension strut.

21. The invention as set forth in claim 9 wherein said tube has said wheel spindle fixedly secured thereto at the lower end thereof.

22. The invention as set forth in claim 21 which includes a coil spring extending around said device and supported at one end by a first spring support located on said tube and at the opposite end thereof by a second spring support located adjacent the connection of said piston rod with said sprung vehicle portion.

23. The invention as set forth in claim 21 wherein said piston rod is rotatably connected to said sprung vehicle portion.

24. The invention as set forth in claim 21 wherein said tube has said wheel spindle fixedly secured thereto at the lower end thereof.

25. The invention as set forth in claim 17 wherein said tube has said wheel spindle fixedly secured thereto at the lower end thereof.

26. The invention as set forth in claim 25 wherein said first and second guide means comprise said piston and cylinder, and said piston rod and a rod guide assembly located adjacent the upper end of said cylinder.

27. The invention as set forth in claim 9 wherein the longitudinal axis of said device defines a pivotal axis about which a wheel mounted on said spindle is pivotable during steering movement thereof, first and second guide means located at longitudinally spaced apart positions along said pivotal axis for guiding said first and second parts for longitudinal sliding movement, and wherein said tube has said wheel spindle fixedly secured thereto at the lower end thereof.

28. The invention as set forth in claim 27 wherein said coil spring is arranged coaxially of said suspension strut.

29. The invention as set forth in claim 27 wherein said piston rod is rotatably connected to said sprung vehicle portion.

30. The invention as set forth in claim 16 wherein said tube has said wheel spindle fixedly secured thereto at the lower end thereof.

31. The invention as set forth in claim 9 which includes a coil spring extending around said device and supported at one end by a first spring support located on said tube and at the opposite end thereof by a second spring support located adjacent the connection of said piston rod with said sprung vehicle portion and wherein said tube has said wheel spindle fixedly secured thereto at the lower end thereof.

32. In a MacPherson-type independent wheel suspension device for an automotive vehicle having sprung and unsprung portions,

said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts,

one of said parts comprising a cylinder and the other of said parts comprising a piston and piston rod reciprocably disposed in said cylinder, with said piston rod extending longitudinally from one end of said cylinder,

said piston rod being connected to said sprung portion of the vehicle,

detachable means on said one telescopic part comprising said piston rod connectable to the sprung body portion of said vehicle so as to provide for relative rotational movement between said piston rod and said sprung body portion,

a tube removably supporting said cylinder,

said tube having a wheel spindle fixedly secured adjacent the lower end thereof and having a removable end portion wherein said shock absorber is removable and replaceable as a cartridge unit through the end of said tube having said removable end portion upon detaching said detachable means,

the longitudinal axis of said device defining a pivotal axis about which a wheel mounted on said spindle is pivotable during steering movement thereof, first and second guide means located at longitudinally spaced

apart positions along said pivotal axis for guiding said first and second parts for longitudinal sliding movement, and

a coil spring extending substantially coaxially around the upper end of said device and supported at one end by a first spring support located on said tube and at the opposite end thereof by a second spring support located adjacent the connection of said piston rod with said sprung vehicle portion.

33. The invention as set forth in claim 32 wherein said coil spring is arranged coaxially of said suspension strut.

34. The invention as set forth in claim 32 wherein said first and second guide means comprise said piston and cylinder, and said piston rod and a rod guide assembly located adjacent the upper end of said cylinder.

35. The invention as set forth in claim 32 wherein said removable end portion is threadably connected to said tube and selectively removable therefrom to permit said removal and replacement of said cartridge unit.

36. In a MacPherson-type independent wheel suspension device for an automotive vehicle having sprung and unsprung portions,

said suspension device comprising a hydraulic tubular shock absorber having a pair of relatively movable telescopic parts,

detachable means on one of said telescopic parts connectable to a body portion of said vehicle and providing for relative rotational movement therebetween,

a tube removably supporting the other of said telescopic parts,

said tube having a wheel spindle mounted thereon and a removable end member at one end thereof which when mounted on said tube retains said shock absorber therein, and when removed, permits removal of said shock absorber through said one end of said tube upon detaching said detachable means.

37. The invention as set forth in claim 36 wherein said removable end member is threadably connected to said tube.

38. The invention as set forth in claim 36 wherein said removable end member is located at the lower end of said tube.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : RE 31,212

DATED : February 7, 1984

INVENTOR(S) : Charles J. Smith

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 2, line 18, delete "the"

Beginning Column 7, line 56, delete up to and including

Column 8, line 6

Signed and Sealed this

Twelfth Day of *March 1985*

[SEAL]

Attest:

DONALD J. QUIGG

Attesting Officer

Acting Commissioner of Patents and Trademarks