IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS

ROBERT BOSCH LLC, Plaintiff, v. TRICO PRODUCTS CORPORATION, AND TRICO PRODUCTS, Defendants.	Case No. 12 CV 437 Judge John F. Grady Magistrate Judge Maria Valdez
TRICO PRODUCTS CORPORATION, Counter-Plaintiff, v. ROBERT BOSCH LLC, AND ROBERT BOSCH GmbH, Counter-Defendants.	JURY TRIAL DEMANDED

SECOND AMENDED COMPLAINT

Plaintiff Robert Bosch LLC ("Plaintiff"), through its attorneys, for its second amended complaint against defendants Trico Products Corporation and Trico Products (collectively "Defendants" or "Trico"), avers as follows:

1. This action arises under the patent laws of the United States, Title 35 of the United States Code (for example, §§ 271, 281, 283, 284 and 285) as hereinafter more fully appears. This Court has jurisdiction over the subject matter of the action pursuant to 28 U.S.C. §§ 1331 and 1338.

COUNT ONE – INFRINGEMENT OF U.S. PATENT NO. 6,530,111

2. On March 11, 2003, United States Patent No. 6,530,111 ("the '111 patent," attached as Exhibit A) was duly and legally issued for an invention in a windshield wiper blade. Plaintiff is the owner of the '111 patent.

3. Defendants have infringed and are still infringing the '111 patent directly and indirectly by making, importing, offering for sale, using and/or selling windshield wiper blades such as the TRICO NeoForm, TRICO Flex, TRICO Tech, TRICO Force, TRICO ExactFit Beam, TRICO Onyx, TRICO Ice, and Duralast Flex, and will continue to do so unless enjoined by this Court.

4. Plaintiff has no adequate remedy at law against Defendants' infringement and, unless Defendants are enjoined from their infringement of the '111 patent, Plaintiff will suffer irreparable harm.

5. Defendants have knowledge of the '111 patent and that the Accused Products named in ¶ 3, when used with "top lock" (or "pinch tab") wiper arms, directly infringe the '111 patent.

6. On information and belief, Defendants contribute to and induce infringement of the '111 patent by advertising the infringing use in their promotional materials, and by instructing purchasers to infringe by posting installation videos on their website and including installation instructions with the Accused Products named in ¶ 3 that show how to install the same on a "top lock" wiper arm. Such infringement is and continues to be willful and deliberate.

7. On information and belief, Defendants made and continue to make such advertisements and provide instructions with the knowledge and intent that use of the Accused Products named in ¶ 3 with a "top lock" wiper arm would infringe the '111 patent.

8. The Accused Products named in ¶ 3 form a material component of the claimed invention of the ’111 patent.

9. The Accused Products named in ¶ 3 include adapters that are intended to be used with a “top lock” wiper arm and are configured to do so.

10. The Accused Products named in ¶ 3 with the associated “top lock” connector are not staple articles or commodities of commerce and have no non-infringing uses.

11. As a result of Defendants’ acts of infringement, Plaintiff has suffered and will continue to suffer damages in an amount to be proven at trial.

COUNT TWO – INFRINGEMENT OF U.S. PATENT NO. 6,553,607

12. On April 29, 2003, United States Patent No. 6,553,607 (“the ’607 patent,” attached as Exhibit B) was duly and legally issued for an invention in a windshield wiper blade. Plaintiff is the owner of the ’607 patent.

13. Defendants have infringed and are still infringing the ’607 patent directly and indirectly by making, importing, offering for sale, using and/or selling windshield wiper blades such as the TRICO NeoForm, TRICO Flex, TRICO Tech, TRICO Force, TRICO ExactFit Beam, TRICO Onyx, TRICO Ice, and Duralast Flex, and will continue to do so unless enjoined by this Court.

14. Plaintiff has no adequate remedy at law against Defendants’ infringement and, unless Defendants are enjoined from their infringement of the ’607 patent, Plaintiff will suffer irreparable harm.

15. Defendants have knowledge of the ’607 patent and that the Accused Products named in ¶ 13, when used with “side lock” (alternatively referred to as “side pin”) wiper arms, directly infringe the ’607 patent.

16. On information and belief, Defendants contribute to and induce infringement of the ’607 patent by advertising the infringing use in their promotional materials, and by instructing purchasers to infringe by posting installation videos on their website and including installation instructions with the Accused Products named in ¶ 13 that show how to install the same on a “side lock” wiper arm. Such infringement is and continues to be willful and deliberate.

17. On information and belief, Defendants made and continue to make such advertisements and provide instructions with the knowledge and intent that use of the Accused Products named in ¶ 13 with a “side lock” wiper arm would infringe the ’607 patent.

18. The Accused Products named in ¶ 13 form a material component of the claimed invention of the ’607 patent.

19. The Accused Products named in ¶ 13 include adapters that are intended to be used with a “side lock” wiper arm and are configured to do so.

20. The Accused Products named in ¶ 13 with the associated “side lock” connector are not staple articles or commodities of commerce and have no non-infringing uses.

21. As a result of Defendants’ acts of infringement, Plaintiff has suffered and will continue to suffer damages in an amount to be proven at trial.

COUNT THREE – INFRINGEMENT OF U.S. PATENT NO. 6, 611,988

22. On September 2, 2003, United States Patent No. 6,611,988 (“the ’988 patent,” attached as Exhibit C) was duly and legally issued for an invention in a windshield wiper blade. Plaintiff is the owner of the ’988 patent.

23. Defendants have infringed and are still infringing the ’988 patent directly and indirectly by making, importing, offering for sale, using and/or selling windshield wiper blades,

such as the TRICO Flex, TRICO Tech, TRICO ExactFit Beam, TRICO Force, TRICO Onyx, TRICO Ice, and Duralast Flex, and will continue to do so unless enjoined by this Court.

24. Plaintiff has no adequate remedy at law against Defendants' infringement and, unless Defendants are enjoined from their infringement of the '988 patent, Plaintiff will suffer irreparable harm.

25. Defendants have knowledge of the '988 patent and such infringement is and continues to be willful and deliberate.

26. Defendants also have knowledge that use of the Accused Products named in ¶ 23 equipped with side lock connectors or adaptors directly infringes the '988 patent.

27. On information and belief, Defendants contribute to and induce infringement of the '988 patent by making available the Accused Products named in ¶ 23 with side lock connectors or adaptors, advertising the infringing use in their promotional materials, instructing purchasers to infringe by posting installation videos on their website, and including installation instructions with the Accused Products named in ¶ 23. Such infringement is and continues to be willful and deliberate.

28. On information and belief, Defendants made and continue to make such advertisements and provide such instructions with the knowledge and intent that use of the Accused Products named in ¶ 23 with side lock connectors or adaptors directly infringes the '988 patent.

29. The Accused Products named in ¶ 23 equipped with side lock connectors or adaptors are not staple articles or commodities of commerce and have no non-infringing uses.

30. As a result of Defendants' acts of infringement, Plaintiff has suffered and will continue to suffer damages in an amount to be proven at trial.

COUNT FOUR – INFRINGEMENT OF U.S. PATENT NO. 6,675,434

31. On January 13, 2004, United States Patent No. 6,675,434 ("the '434 patent," attached as Exhibit D) was duly and legally issued for an invention in a windshield wiper blade. Plaintiff is the owner of the '434 patent.

32. Defendants have infringed and are still infringing the '434 patent directly and indirectly by making, importing, offering for sale, using and/or selling windshield wiper blades, such as the TRICO NeoForm, TRICO Flex, TRICO Tech, TRICO Force, TRICO ExactFit Beam, TRICO Onyx, TRICO Ice, MO-22A, and Duralast Flex, and will continue to do so unless enjoined by this Court.

33. Plaintiff has no adequate remedy at law against Defendants' infringement and, unless Defendants are enjoined from their infringement of the '434 patent, Plaintiff will suffer irreparable harm.

34. Defendants have knowledge of the '434 patent and such infringement is and continues to be willful and deliberate.

35. Defendants also have knowledge that use of the Accused Products named in ¶ 32 directly infringes the '434 patent.

36. On information and belief, Defendants contribute to and induce infringement of the '434 patent by making available the Accused Products named in ¶ 32, advertising the infringing use in their promotional materials, instructing purchasers to infringe by posting installation videos on their website, and including installation instructions with the Accused Products named in ¶ 32. Such infringement is and continues to be willful and deliberate.

37. On information and belief, Defendants made and continue to make such advertisements and provide such instructions with the knowledge and intent that use of the Accused Products named in ¶ 32 directly infringes the ’434 patent.

38. The Accused Products named in ¶ 32 are not staple articles or commodities of commerce and have no non-infringing uses.

39. As a result of Defendants’ acts of infringement, Plaintiff has suffered and will continue to suffer damages in an amount to be proven at trial.

COUNT FIVE – INFRINGEMENT OF U.S. PATENT NO. 6,836,926

40. On January 4, 2005, United States Patent No. 6,836,926 (“the ’926 patent,” attached as Exhibit E) was duly and legally issued for an invention in a windshield wiper blade. Plaintiff is the owner of the ’926 patent.

41. Defendants have infringed and are still infringing the ’926 patent directly and indirectly by making, importing, offering for sale, using and/or selling windshield wiper blades, such as the TRICO NeoForm, TRICO Flex, TRICO Tech, TRICO Force, TRICO ExactFit Beam, TRICO Teflon Shield, TRICO Onyx, TRICO Ice, MO-22A, and Duralast Flex, and will continue to do so unless enjoined by this Court.

42. Plaintiff has no adequate remedy at law against Defendants’ infringement and, unless Defendants are enjoined from their infringement of the ’926 patent, Plaintiff will suffer irreparable harm.

43. Defendants have knowledge of the ’926 patent and such infringement is and continues to be willful and deliberate.

44. Defendants also have knowledge that use of the Accused Products named in ¶ 41 directly infringes the ’926 patent.

45. On information and belief, Defendants contribute to and induce infringement of the ’926 patent by making available the Accused Products named in ¶ 41, advertising the infringing use in their promotional materials, instructing purchasers to infringe by posting installation videos on their website, and including installation instructions with the Accused Products named in ¶ 41. Such infringement is and continues to be willful and deliberate.

46. On information and belief, Defendants made and continue to make such advertisements and provide such instructions with the knowledge and intent that use of the Accused Products named in ¶ 41 directly infringes the ’926 patent.

47. The Accused Products named in ¶ 41 are not staple articles or commodities of commerce and have no non-infringing uses.

48. As a result of Defendants’ acts of infringement, Plaintiff has suffered and will continue to suffer damages in an amount to be proven at trial.

COUNT SIX – INFRINGEMENT OF U.S. PATENT NO. 6,973,698

49. On December 13, 2005, United States Patent No. 6,973,698 (“the ’698 patent,” attached as Exhibit F) was duly and legally issued for an invention in a windshield wiper blade. Plaintiff is the owner of the ’698 patent.

50. On information and belief, Defendants have infringed and are still infringing the ’698 patent directly and indirectly by making, importing, offering for sale, using and/or selling windshield wiper blades, such as the TRICO NeoForm, TRICO Flex, TRICO Tech, TRICO Force, TRICO ExactFit Beam, TRICO Teflon Shield, TRICO Onyx, TRICO Ice, MO-22A, and Duralast Flex, and will continue to do so unless enjoined by this Court.

51. Plaintiff has no adequate remedy at law against Defendants' infringement and, unless Defendants are enjoined from their infringement of the '698 patent, Plaintiff will suffer irreparable harm.

52. Defendants have knowledge of the '698 patent and such infringement is and continues to be willful and deliberate.

53. Defendants also have knowledge that use of the Accused Products named in ¶ 50 directly infringes the '698 patent.

54. On information and belief, Defendants contribute to and induce infringement of the '698 patent by making available the Accused Products named in ¶ 50, advertising the infringing use in their promotional materials, instructing purchasers to infringe by posting installation videos on their website, and including installation instructions with the Accused Products named in ¶ 50. Such infringement is and continues to be willful and deliberate.

55. On information and belief, Defendants made and continue to make such advertisements and provide such instructions with the knowledge and intent that use of the Accused Products named in ¶ 50 directly infringes the '698 patent.

56. The Accused Products named in ¶ 50 are not staple articles or commodities of commerce and have no non-infringing uses.

57. As a result of Defendants' acts of infringement, Plaintiff has suffered and will continue to suffer damages in an amount to be proven at trial.

COUNT SEVEN – INFRINGEMENT OF U.S. PATENT NO. 6,944,905

58. On September 20, 2005, United States Patent No. 6,944,905 ("the '905 patent," attached as Exhibit G) was duly and legally issued for an invention in a windshield wiper blade. Plaintiff is the owner of the '905 patent.

59. On information and belief, Defendants have infringed and are still infringing the ’905 patent directly and indirectly by making, importing, offering for sale, using and/or selling windshield wiper blades, such as the Duralast Flex, and will continue to do so unless enjoined by this Court.

60. Plaintiff has no adequate remedy at law against Defendants’ infringement and, unless Defendants are enjoined from their infringement of the ’905 patent, Plaintiff will suffer irreparable harm.

61. Defendants have knowledge of the ’905 patent and such infringement is and continues to be willful and deliberate.

62. Defendants also have knowledge that use of the Accused Products named in ¶ 59 directly infringes the ’905 patent.

63. On information and belief, Defendants have contributed to and induced infringement of the ’905 patent by making available the Accused Product named in ¶ 59, advertising the infringing use in their promotional materials, instructing purchasers to infringe by posting installation videos on their website, and including installation instructions with the Accused Product named in ¶ 59. Such infringement is willful and deliberate.

64. On information and belief, Defendants made such advertisements and provided such instructions with the knowledge and intent that use of the Accused Product named in ¶ 59 directly infringes the ’905 patent.

65. The Accused Product named in ¶ 59 is not a staple article or commodity of commerce and has no non-infringing uses.

66. As a result of Defendants’ acts of infringement, Plaintiff has suffered and will continue to suffer damages in an amount to be proven at trial.

COUNT EIGHT – INFRINGEMENT OF U.S. PATENT NO. 6,292,974

67. On September 25, 2001, United States Patent No. 6,292,974 ("the '974 patent," attached as Exhibit H) was duly and legally issued for an invention in a windshield wiper blade. Plaintiff is the owner of the '974 patent.

68. On information and belief, Defendants have infringed and are still infringing the '974 patent directly and indirectly by making, importing, offering for sale, using and/or selling windshield wiper blades, such as the TRICO NeoForm, TRICO Flex, TRICO Tech, TRICO Force, TRICO ExactFit Beam, TRICO Onyx, TRICO Ice, MO-22A, and Duralast Flex, and will continue to do so unless enjoined by this Court.

69. Plaintiff has no adequate remedy at law against Defendants' infringement and, unless Defendants are enjoined from their infringement of the '974 patent, Plaintiff will suffer irreparable harm.

70. Defendants have knowledge of the '974 patent and such infringement has been and continues to be willful and deliberate.

71. Defendants also have knowledge that use of the Accused Products named in ¶ 68 directly infringes the '974 patent.

72. On information and belief, Defendants contribute to and induce infringement of the '974 patent by making available the Accused Products named in ¶ 68, advertising the infringing use in their promotional materials, instructing purchasers to infringe by posting installation videos on their website, and including installation instructions with the Accused Products named in ¶ 68. Such infringement is and continues to be willful and deliberate.

73. On information and belief, Defendants made and continue to make such advertisements and provide such instructions with the knowledge and intent that use of the Accused Products named in ¶ 68 directly infringes the ’974 patent.

74. The Accused Products named in ¶ 68 are not staple articles or commodities of commerce and have no non-infringing uses.

75. As a result of Defendants’ acts of infringement, Plaintiff has suffered and will continue to suffer damages in an amount to be proven at trial.

WILLFULNESS

76. The acts of infringement set forth above have occurred with full knowledge of the ’111, ’607, ’988, ’434, ’926, ’698, ’905, and ’974 patents and have been willful and deliberate, making this case exceptional within the meaning of the United States patent laws.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff demands following relief:

A. A judgment in favor of Plaintiff that Defendants have infringed, directly and indirectly, by way of inducement and/or contributory infringement, the ’111, ’607, ’988, ’434, ’926, ’698, ’905, and ’974 patents;

B. A permanent injunction, enjoining Defendants and their officers, directors, agents, servants, employees, affiliates, divisions, branches, subsidiaries, parents, and all others acting in concert or privity with any of them from infringing, inducing the infringement of, or contributing to the infringement of the aforementioned patents;

C. An award to Plaintiff of the damages to which it is entitled under at least 35 U.S.C. § 284 for Defendants’ past infringement and any continuing or future infringement, including both compensatory damages and treble damages for willful infringement;

D. A judgment and order requiring Defendants to pay the costs of this action (including all disbursements), as well as attorneys' fees as provided by 35 U.S.C. § 285;

E. An award to Plaintiff of pre-judgment and post-judgment interest on its damages; and

F. Such other further relief in law or equity to which Plaintiff may be justly entitled.

JURY DEMAND

Plaintiff demands a trial by jury.

Dated: March 3, 2014

Respectfully submitted,

/s/ William P. Oberhardt

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CERTIFICATE OF SERVICE

I hereby certify that on March 3, 2014, the foregoing Second Amended Complaint (with Exhibits A–H) was filed electronically with the Clerk of Court using the CM/ECF system, to be served by operation of the Court's electronic filing system upon all counsel of record.

/s/ Ksenia Takhistova

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Attorney for Plaintiff/Counter-Defendant Robert Bosch LLC

EXHIBIT A

US006530111B1

(12) **United States Patent**
Kotlarski

(10) **Patent No.: US 6,530,111 B1**
(45) **Date of Patent: Mar. 11, 2003**

(54) **WIPER DEVICE FOR THE WINDOWS OF MOTOR VEHICLES**

(75) Inventor: **Thomas Kotlarski**, Bad Neuenahr (DE)

(73) Assignee: **Robert Bosch GmbH**, Stuggart (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/701,219**

(22) PCT Filed: **Nov. 6, 1999**

(86) PCT No.: **PCT/DE99/03557**

§ 371 (c)(1),
(2), (4) Date: **Jan. 2, 2001**

(87) PCT Pub. No.: **WO00/59761**

PCT Pub. Date: **Oct. 12, 2000**

(30) **Foreign Application Priority Data**

Mar. 30, 1999 (DE) 199 14 413

(51) **Int. Cl.**[7] **B60S 1/40**
(52) **U.S. Cl.** **15/250.32**; 15/250.43
(58) **Field of Search** 15/250.32, 250.43, 15/250.44, 250.361, 250.451, 250.33

(56) **References Cited**

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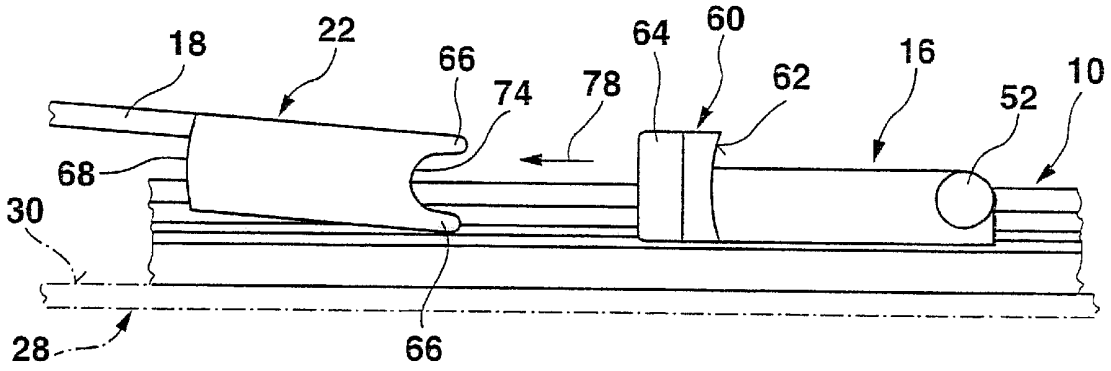
Primary Examiner—Gary K. Graham
(74) *Attorney, Agent, or Firm*—Michael J. Striker

(57) **ABSTRACT**

A wiper apparatus is proposed that is used to clean windows of motor vehicles. The wiper apparatus has a wiper arm **(18)**, guided on the motor vehicle and driven in pendulum motion, on whose free end, remote from the pendulum shaft **(88)**, a wiper blade **(10)**, elongated transversely to the pendulum direction (double arrow **86**) and capable of being pressed against the window **(28)**, is separably hinged via a connection device **(14)** that has coupling elements **(22** and **16)** associated with the wiper arm and the wiper blade, respectively, wherein the pivot axis **(54)** extends substantially in the pendulum direction, and the wiper apparatus has at least one support shoulder **(44, 46** and **68)**, solidly connected to the wiper arm and pointing toward the pendulum shaft **(88)**, which shoulder is located opposite an associated interception shoulder **(62)**, solidly connected to the wiper blade and pointing away from the pendulum shaft **(88)**. To assure problem-free mounting of the wiper blade on the wiper arm and problem-free removal of the wiper blade from the wiper arm, even if for structural reasons the wiper arm cannot be raised in a plane that is vertical to the window, transverse to the wiping direction, at least one of the two shoulders **(44, 46, 68; 62)** can be moved counter to a restoring force all the way out of the opposed position relative to the other shoulder **(62; 44, 46, 68)**.

14 Claims, 3 Drawing Sheets



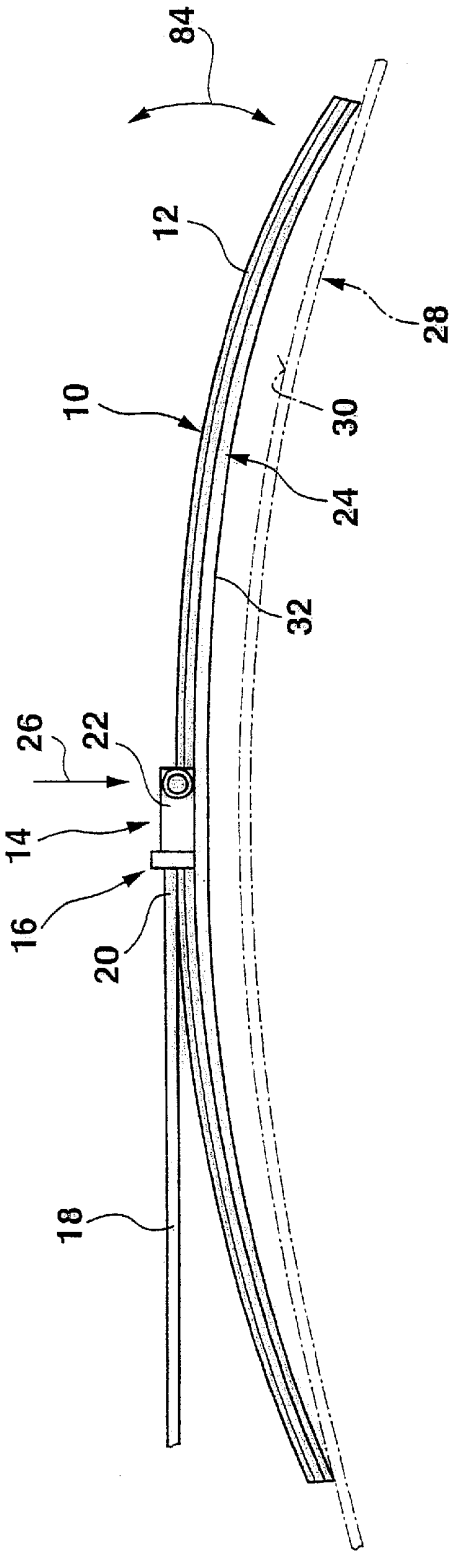


Fig. 1

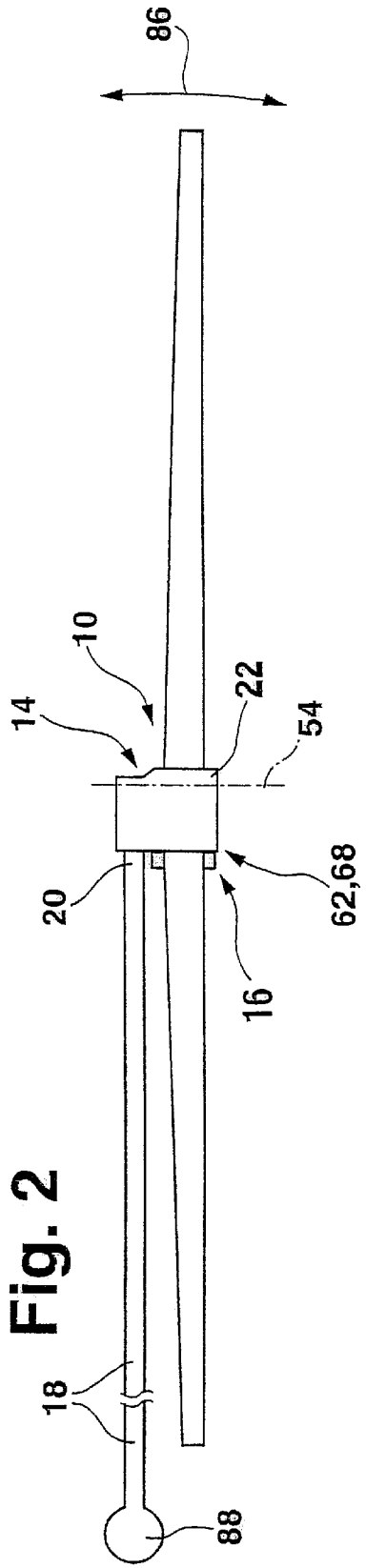


Fig. 2

Fig. 3

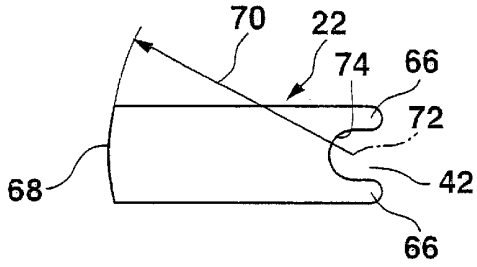


Fig. 4

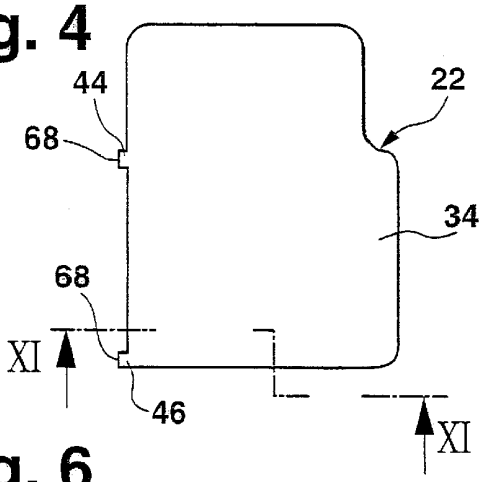


Fig. 5

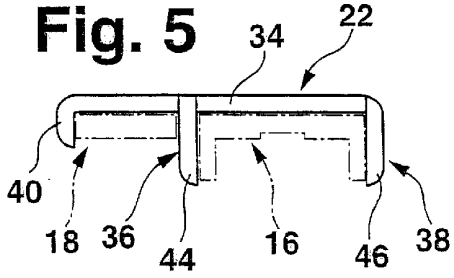


Fig. 6

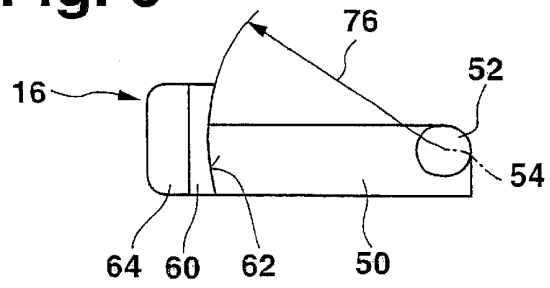


Fig. 7

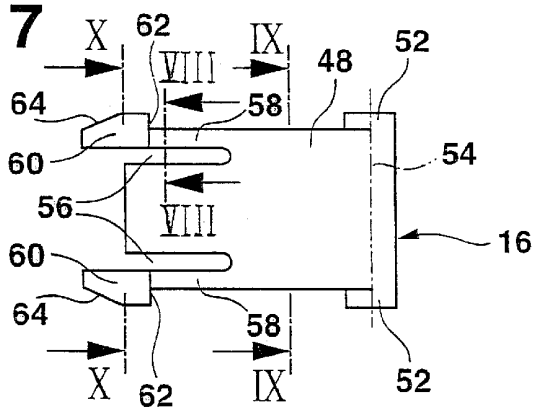


Fig. 8

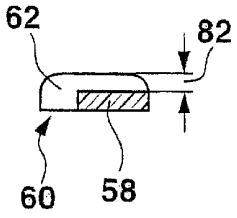
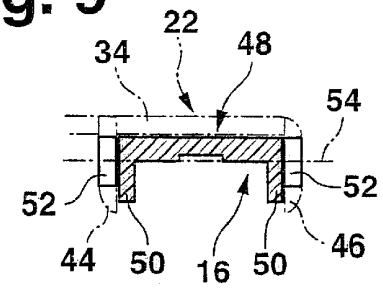


Fig. 9



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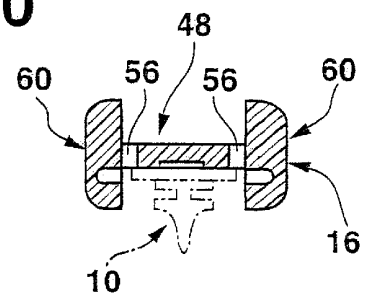


Fig. 11

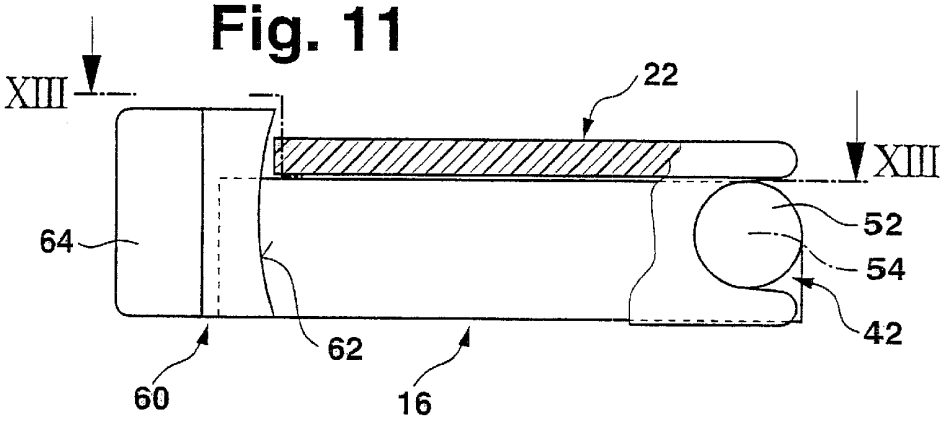


Fig. 13

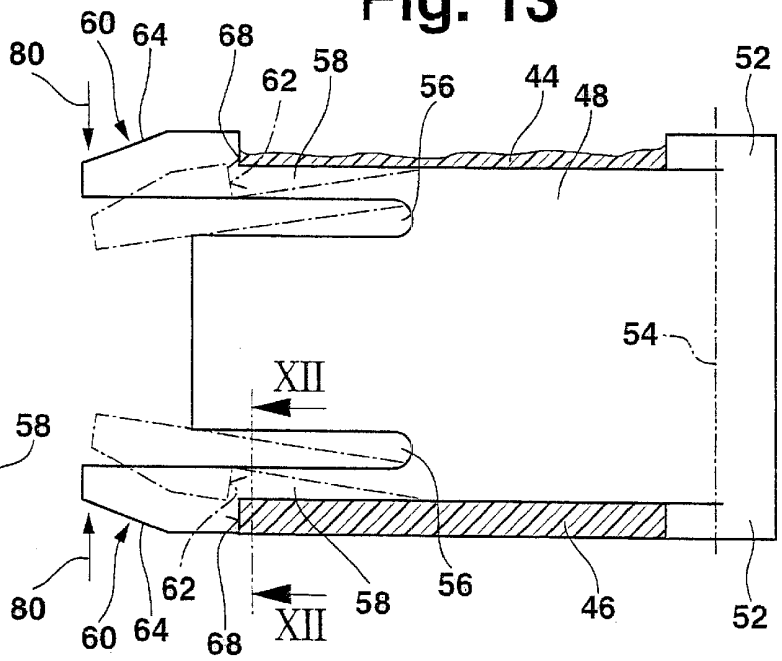
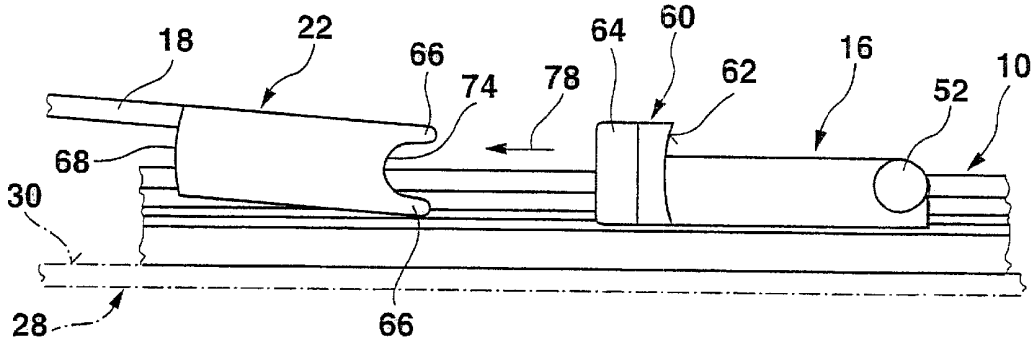


Fig. 12

Fig. 14



WIPER DEVICE FOR THE WINDOWS OF MOTOR VEHICLES

PRIOR ART

The invention is based generally on a wiper apparatus. In a wiper apparatus of this type in the prior art (German Patent Application DE 19 75 78 72.1, as yet unpublished), the support shoulder and the interception shoulder are intended to absorb the centrifugal force that acts on the wiper blade during wiping operation, so that the hinge between the wiper blade and the wiper arm is entirely relieved relative to this force. Since for mounting the wiper blade on the wiper arm, the wiper arm has to be swiveled away from the window, difficulties arise if—for instance for the sake of vehicle body styling—the swivel joint is concealed by the vehicle body, thus blocking or restricting the swiveling motion.

ADVANTAGES OF THE INVENTION

In the wiper apparatus according to the invention, it is possible to remove the wiper blade from the wiper arm or mount it on it without performing a swiveling motion of the wiper arm beforehand, since once the shoulder or shoulders have been moved out of the opposed position, it is possible to pull the wiper blade off the wiper arm away from the pendulum shaft. This is true particularly for the hinge connection, shown in the exemplary embodiment, between the wiper blade and the wiper arm, in accordance with which a hinge peg of the wiper blade is supported in a bearing fork of the wiper arm that is open in the pull-off direction. Furthermore, the expensive swivel joint can be omitted

For production reasons, it is advantageous to dispose the support shoulder that is solidly connected to the wiper arm on the coupling piece associated with the wiper arm, and to dispose the interception shoulder associated with the wiper blade on the coupling part associated with the wiper blade of the connection device.

A wiper apparatus of compact structure is obtained if the support shoulder and the interception shoulder are disposed between the pendulum shaft and the pivot axis.

An especially simple arrangement of the support and interception shoulders can be accomplished if in a feature of the invention the coupling piece associated with the wiper arm has a wall, located in a plane vertical to the window and extending substantially in the direction of the longitudinal axis of the wiper arm, which wall is adjacent to a surface of the coupling part associated with the wiper blade, and if furthermore the support shoulder is embodied on the wall and the interception shoulder is embodied on the surface.

In a connection device of very shallow design, the invention can be realized if the coupling piece associated with the wiper arm, transversely to the longitudinal axis of the wiper arm, has a U-shaped cross section; if furthermore disposed in each of the legs of the U of this coupling piece is a respective bearing receptacle for a bearing peg of the coupling part associated with the wiper blade, which dips between the legs of the U of the coupling piece associated with the wiper arm; and if finally the inside of at least one leg of the U forms the wall that is provided with the support shoulder.

Expediently, the coupling part associated with the wiper blade has a base body, on which the two bearing pegs are disposed in such a way that they have a common pivot axis, and furthermore at least one face of the base body forms the surface that is provided with the interception shoulder.

If both the support shoulder and the interception shoulder have a course that is curved about the axis of the hinge, and the respective radius of curvature corresponds to the respective spacing from the pivot axis, a comparatively large-area contact of the two shoulders with one another results, which reduces their wear.

An especially simple, economical embodiment of the invention is achieved if one end of one of spring tongues, which are deflectable substantially in the direction of the pivot axis, is retained on the base body, and the interception shoulder is disposed on the free ends of the spring tongues.

To further simplify the invention, the base body is made from a spring-elastic plastic, and the spring tongue provided with the interception shoulder is integrally joined to it.

An especially simple version of the invention, because it has no additional components, results if a slit open at the edge toward the shoulder is present in the region of the interception shoulder between the base body and the spring tongue, the width of which slit is greater than the effective width of the interception shoulder.

In certain applications it can be advantageous if a plurality of support shoulders and interception shoulders are disposed on each of the two coupling elements.

If one support shoulder is embodied on each of the two legs of the U of the coupling piece associated with the wiper arm, which legs fit over the base bodies of the coupling part associated with the wiper blade, and furthermore a spring tongue provided with the interception shoulder is disposed on each of the two sides, adjacent the legs of the U, of the base body, an especially operationally reliable connection between the wiper blade and the wiper arm is obtained as a result of the double detent locking thus achieved.

According to the refinement of the invention, the two components of the connection device are separable from one another with a simple linear pulling-off motion oriented away from the pendulum shaft.

Especially simple conditions for this kind of pull-off or slip-on motion result if forklike bearing receptacles, associated with the hinge peg, have opening slits, pointing away from the pendulum shaft, outward on the coupling piece associated with the wiper arm, into which slits the bearing pegs of the coupling part associated with the wiper blade can be introduced.

Further advantageous refinements and features of the invention are disclosed in the ensuing description of an exemplary embodiment shown in the associated drawing.

DRAWING

In the drawing:

FIG. **1** is a side view of a wiper apparatus according to the invention;

FIG. **2** is a plan view of the wiper apparatus of FIG. **1**;

FIG. **3** is an enlarged side view of a coupling piece associated with the wiper arm;

FIG. **4** is a plan view on the coupling piece of FIG. **3**;

FIG. **5** is another side view of the coupling piece of FIG. **3**;

FIG. **6** is an enlarged side view of a coupling part associated with the wiper blade;

FIG. **7** is a plan view on the coupling part of FIG. **6**;

FIG. **8** is a fragmentary section along the line VIII—VIII through the coupling part of FIG. **7**;

FIG. **9** is a section rotated by 90°, taken along the line IX—IX through the coupling part of FIG. **7**;

FIG. **10** is a section rotated by 90°, taken along the line X—X through the coupling part of FIG. **7**;

FIG. **11** in an enlarged view shows the assembly of the coupling elements of FIGS. **3** and **6** and in section along the line XI—XI of FIG. **4**;

FIG. **12** is a fragmentary section along the line XII—XII in FIG. **13** through the arrangement of FIG. **11**;

FIG. **13** is a section taken along the line XIII—XIII through the arrangement of FIG. **11**; and

FIG. **14** shows the mounted positions of the wiper arm and the wiper blade.

DESCRIPTION OF THE EXEMPLARY EMBODIMENT

A wiper blade **10** shown in FIGS. **1** and **2** has a bandlike-elongated, spring-elastic, one- or multi-piece support element **12**, on whose top, toward with the window to be wiped, there is a coupling part **16** associated with the wiper blade, which part belongs to a connection device **14** and with the aid of which the wiper blade **10** can be connected separably to a driven wiper arm **18** that is guided on the body of a motor vehicle. To that end, the wiper arm is provided on its free end **20** with a coupling piece **22** that also belongs to the connection device **14** or in other words to the wiper arm. An elongated, rubber-elastic wiper strip **24** is disposed parallel to the longitudinal axis on the underside, toward the window, of the support element **12**. The wiper arm **16** and thus also the coupling piece **22** cooperating with the coupling part **16** of the wiper blade **10** are urged in the direction of the arrow **26** toward the window **28** to be wiped, whose surface to be wiped is represented in FIG. **3** by a dot-dashed line **30**. Since the dot-dashed line **30** is intended to represent the most pronounced curvature of the window surface, it is clearly apparent that the curvature of the unstressed wiper blade **10**, resting with both ends on the window **28**, is greater than the maximum window curvature (FIG. **1**). Under the contact pressure (arrow **26**), the wiper blade **10** presses with the wiper lip **32** of its wiper strip **24** against the window surface **30** over the full length of the wiper blade. In the process, a tension builds up in the bandlike, spring-elastic support element **12** that assures a proper contact of the wiper strip **24**, or wiper lip **32**, over its full length on the vehicle window **28**. Since the window, which as a rule is spherically curved, is not a portion of a surface of a sphere the wiper blade **10** relative to the wiper arm **16** must be capable of constant adaptation during its wiping motion to the respective location and course of the window surface **30**. The connection device **14** is therefore simultaneously embodied as a hinge connection (swivel joint) between the wiper blade **10** and the wiper arm **18**, the pivot axis **54** of which connection extends essentially in the wiping or pendulum direction (double arrow **86** in FIG. **2**).

The special design of the attachment or connection device **14** and of the two apparatus elements **16** and **22** belonging to it will now be described in further detail.

The coupling piece **22**, shown separately in FIGS. **3–5**, has a base plate **34**, on which two spaced-apart guide walls **36** and **38** are located. One guide wall **36** is mounted in the middle region of the base plate **34**, while the other guide wall **38** is mounted on a peripheral region of the base plate **34**. The two guide walls **36** and **38** are disposed parallel to one another. In the mounted wiper apparatus, they extend in the longitudinal direction of the wiper arm, in a plane vertical to the window **28**. In this portion of the coupling piece **22**, the result is accordingly a U-shaped cross section, and the two guide walls **36**, **38** form the legs of the U that attach to the U-shaped base plate **34**. Spaced apart from the first guide wall **36** and on the side remote from the lower wall **38**, the base plate **34** is provided with a clawlike attachment **40**, which is likewise oriented parallel to the wall **36**. Viewed from the plate **34** outward, the attachment **40** is shorter than the two guide walls **36** and **38** (FIG. **5**). From FIG. **3** it can be seen that the two guide walls **36** and **38** are each provided on one face end with a peripherally open receiving or bearing opening **42**, forming a respective receiving or bearing fork **42**. The other face ends of the guide walls **36** and **38** protrude past the base plate **34** with support shoulders **44** and **46**, which also continue into the region of the base plate (FIG. **4**).

The design of the coupling part **16** associated with the wiper blade can be seen from FIGS. **6–10**. It has a base body **48** (FIG. **9**) of basically U-shaped cross section, the two legs **50** of which U are spaced apart from one another. On each of the two outer walls or outer faces, facing away from one another, of the legs **50** of the U, there is a respective bearing peg **52**, and the two peg axes are aligned with one another and form a common pivot axis **54**. As FIGS. **6** and **7** show in particular, the two bearing pegs **52** are embodied on one end portion of the base body **48**. On the other end portion of the base body **16**, the base body is provided with two peripherally open slits **56**, which are disposed directly on the inside of the two legs **50** of the U. Since the coupling part **16** is made from an elastic plastic, the result is two spring tongues **58**, joined integrally to the base body **48**, which are formed by the legs **50** of the U. In the exemplary embodiment, these spring tongues **58** extend past the U-shaped base body **48**. On their free ends, the spring tongues **58** are provided with support strips **60**, which extend transversely to the longitudinal direction past the U-shaped base body **48** (FIG. **10**). The support strips **60** also extend past the outer sides or faces, facing away from one another, of the legs **50** of the U. Accordingly, on each of the two support strips **60** a respective interception shoulder **62** is formed, attaching to the respective outer face and each associated with one of the support shoulders **44** of the coupling piece **22**. In addition, on their free ends remote from the bearing pegs **52**, each of the two support strips **60** is provided with a respective run-up bevel **64**, so that the two support strips narrow toward the free ends of the spring tongues **58** (FIG. **7**). In adaptation of the coupling piece **22** associated with the wiper arm to the coupling part **16** associated with the wiper blade, the bearing forks **42**, which are open on the side remote from the pendulum shaft **88**, of the coupling piece **22** are adapted to the diameter of the bearing pegs **52** of the coupling part **16**. This means that the spacing of the two tines **66** of the fork from one another assures a proper lateral guidance of the two bearing pegs **52** when they are introduced into the fork. FIG. **3** also shows that the support faces **68** of the support shoulders **44** and **46** extend with a radius **70** whose center **72** is identical to a further center about which a bearing or guide face **74** of the bearing fork **42** extends. The radius of curvature of the guide face **74** corresponds to the radius of the jacket faces of the bearing pegs **52**. Since both centers of the two bearing forks **42** coincide with the center **72** of the support faces **44** and **46**, the result is again an axis extending through these two centers **72**, or pivot axis, which is identical to the pivot axis **54** once the two components belonging to the connection device **14** (that is, the coupling part **16** and the coupling piece **22**) have been put together (FIG. **11**). It should also be noted that—as FIG. **6** in particular shows—the interception shoulders **62** embodied on the two support strips **60** in their course also follow a radius **76** that is identical to the radius **70** of the support faces **68**.

From FIG. **5**, it can be seen that the spacing between the attachment **40** and the inner guide wall **36** is maintained such that a reception channel for the wiper arm **18** is obtained. The spacing between the two guide walls **36** and **38** is adapted to the width of the base body **48** of the coupling part **16**. For the sake of clarity, the contours of the wiper arm **18** and the coupling part **16** have been shown in dot-dashed lines in the mounted position in FIG. **5**. It can also be seen there that the walls **36**, **38** are adjacent to the surfaces associated with them—that is, the outsides of the legs **50** of the U—in such a way that good lateral guidance of the wiper blade **10** on the wiper arm **18**, **22** results. Conversely, dot-dashed lines in FIG. **9** indicate the mounted position of the coupling piece **22** on the coupling part **16**. FIG. **10** shows the mounting position of the coupling part **16** on the wiper blade **10**, the wiper blade being represented by dot-dashed lines.

In order to secure the wiper blade, provided with the coupling part **16**, to the wiper arm **18** that carries the coupling piece **22**, first the wiper blade is put in the position shown in FIG. **14** relative to the wiper arm **18**. Next, the wiper blade is thrust in the direction of the arrow **78**, and care is taken that the spring tongues **58** enter between the two guide walls **36** and **38**. During this mounting motion **78**, the run-up bevels **64** in the region of the bearing fork **42** first strike the guide walls **36** and **38**, so that the spring tongues **58**, together with their support strips **60**, are deflected in the direction of the arrows **80** in FIG. **13**, until they reach the position shown in dot-dashed lines in FIG. **13**. Since the width of the slits **56** is greater than the effective width **82** of the interception shoulders **62**, problem-free passage of the coupling part **16** through the channel defined by the guide walls **36** and **38** of the coupling piece **22** is possible. Once the operating position between the wiper arm and the wiper blade as shown in FIGS. **11**, **12** and **13** is reached, the spring tongues **58**, which until now have been prestressed, spring back, counter to the direction of the arrows **80**, into their outset position shown in solid lines in FIG. **13**. After that, the interception shoulders **62** of the coupling part **16** and the support faces **68** of the support shoulders **44** and **46** of the coupling piece **22** are located directly opposite one another. As a result of the attendant adaptation of the support face radii **70** and the interception shoulder radii **76**, a practically clearance-free connection between the wiper arm and the wiper blade is then assured, because in the position then attained, the jacket faces of the bearing pegs **52** also rest on the guide faces **74** of the bearing forks **42**. As FIG. **14** shows, all that is required to attach the wiper blade **10** to the wiper arm **18** is a linear motion (arrow **78**), with no need to raise the wiper arm **18** outward past its operational position.

For removing the wiper blade **10** from the wiper arm **18**, the two spring tongues **58** must be deflected in the direction of the arrows **80**, counter to the spring force or restoring force, and specifically far enough that problem-free passage of the support strips **60** is possible through the receiving channel of the wiper arm bounded by the guide walls **36** and **38**, counter to the direction of the arrow **78** in FIG. **14**. Once again, this does not require lifting the wiper arm **18** from the window past its operational position. It is clear particularly from FIG. **11** that between the wiper blade **10** and the wiper arm **18**, or between the coupling part **16** and the coupling piece **22**, a swiveling motion about the pivot axis **54** in the direction of the double arrow **84** in FIG. **1** is possible, without causing the support shoulders and interception shoulders to come completely out of their opposed position, so that an operationally reliable connection between the wiper arm **18** and the wiper blade **10** is achieved. This pivoting motion is required for the adaptation, explained at the outset, of the wiper blade to the course of the window surface **30**.

It can also be seen from FIG. **2** that the pivot axis **54** is located essentially in the direction of the wiping or pendulum direction (double arrow) **86**, and that in the mounted wiper apparatus, the support shoulders **44**, **46** provided with the support faces **68** and the interception shoulder **62** are located between the pendulum shaft **88** and the pivot axis **54**. From FIGS. **11**, **13** and **14**, it can be seen that the support shoulders **44** and **46**, or **68**, solidly connected to the wiper arm point toward the pendulum shaft **88** (FIG. **2**), and that the interception shoulders **62**, pointing away from the pendulum shaft **88**, are oriented toward the support shoulders. From the above functional description, it can also be seen that at least one of the two shoulders is movable counter to a restoring force entirely out of the opposed position relative to the other shoulder. In this case, the restoring force is the force counter to which the spring tongues **58** must be moved outward (FIG. **13**) for the sake of mounting and unmounting between the wiper blade **10** and the wiper arm **18**.

What is claimed is:

1. A wiper apparatus for windows of motor vehicles, comprising at least one wiper arm **(18)**, guided on the motor vehicle and driven in pendulum motion, wherein on a free end of the wiper arm remote from a pendulum shaft **(88)**, a wiper blade **(10)**, elongated transversely to a direction of the pendulum motion (double arrow **86**) and capable of being pressed against the window **(28)**, is separably hinged via a connection device **(14)** that has first and second pivotally connected coupling elements **(22** and **16)** associated with the wiper arm and the wiper blade, respectively, wherein a pivot axis **(54)** of the device extends substantially in the pendulum direction, and the wiper apparatus has at least one support shoulder **(44, 46; 68)**, solidly connected to the first coupling element on the wiper arm and pointing toward the pendulum shaft **(88)**, said support shoulder is located opposite an associated interception shoulder **(62)**, solidly connected to the second coupling element on the wiper blade and pointing away from the pendulum shaft **(88)**, wherein at least one of the two shoulders **(44, 46, 68; 62)** can be moved counter to a restoring force all the way out of the opposed position relative to the other shoulder **(62; 44, 46, 68)**, and further comprising, said second coupling element having a base body **(48)** with spring tongues **(58)** extending therefrom said spring tongues deflectable substantially in a direction of the pivot axis **(54)**, and wherein the interception shoulder **(62)** is disposed on a free end of one of said spring tongues.

2. The wiper apparatus of claim **1**, wherein the support shoulder **(44, 46, 68)** solidly connected to the wiper arm is disposed on the first coupling element **(22)** associated with the wiper arm.

3. The wiper apparatus of claim **2**, wherein the first coupling element **(22)** associated with the wiper arm has a wall **(36, 38)**, located in a plane vertical to the window **(28)** and extending substantially in a direction of a longitudinal axis of the wiper arm, wherein said wall is adjacent to a surface of the second coupling element **(16)** associated with the wiper blade, and wherein the support shoulder **(44, 46, 68)** is embodied on the wall and the interception shoulder **(62)** is embodied on the surface.

4. The wiper apparatus of claim **3**, wherein the first coupling element **(22)** associated with the wiper arm, transversely to the longitudinal axis of the wiper arm **(18)**, has a U-shaped cross section and has two legs; wherein disposed in each of the legs **(36, 38)** of the U of the first coupling element **(22)** is a respective bearing receptacle **(42)** for a

bearing peg (52) of the second coupling element (16) associated with the wiper blade, wherein said second coupling element (16) dips between the legs of the first coupling element (22) associated with the wiper arm; and wherein an inside of at least one of said legs (36, 38) forms the wall that is provided with the support shoulder.

5. The wiper apparatus of claim 4, wherein a plurality of support shoulders (44) and interception shoulders (62) are disposed on each of the two coupling elements (16 and 22).

6. The wiper apparatus of claim 3, wherein the second coupling element (16) associated with the wiper blade has a base body (48), on which two bearing pegs (52) are disposed in such a way that the bearing pegs define the pivot axis (54), and at least one face of the base body forms the surface that is provided with the interception shoulder (62).

7. The wiper apparatus of claim 1, wherein the support shoulder (44, 46, 68) and the interception shoulder (62) are disposed between the pendulum shaft (88) and the pivot axis (54).

8. The wiper apparatus of claim 1, wherein both the support shoulder (44, 46, 68) and the interception shoulder (62) have a course that is curved about the axis (54), and wherein a respective radius of curvature (70 and 76), of the shoulders corresponds to a respective spacing from the pivot axis (54).

9. The wiper apparatus of claim 1, wherein the base body (48) is made from a spring-elastic plastic, and wherein the spring tongue (58) provided with the interception shoulder is integrally joined to it.

10. The wiper apparatus of claim 9, wherein a slit (56) is provided in the base body and is open at an edge thereof, said slit is provided in a region of the interception shoulder (62) between the base body (48) and the spring tongue (58) provided with the interception shoulder, wherein a width of said slit is greater than an effective width (82) of the interception shoulder (62).

11. The wiper apparatus of claim 1, wherein the coupling elements of the connection device (14) are separable from one another in direction away from the pendulum shaft (88).

12. the wiper apparatus of claim 11, wherein forked bearing receptacles (42) are provided on said first coupling element, said receptacles are associated with a hinge peg (52) provided on the second coupling element, said receptacles have opening slits, pointing away from the pendulum shaft (88).

13. A wiper apparatus for windows of motor vehicles, comprising at least one wiper arm (18), guided on the motor vehicle and driven in pendulum motion, wherein on a free end of the wiper arm remote from a pendulum shaft (88), a wiper blade (10), elongated transversely to a direction of the pendulum motion (double arrow 86) and capable of being pressed against the window (28), is separably hinged via a connection device (14) that has first and second pivotally connected coupling elements (22 and 16) associated with the wiper arm and the wiper blade, respectively, wherein a pivot axis (54) of the device extends substantially in the pendulum direction, and the wiper apparatus has at least one support shoulder (44, 46; 68), solidly connected to the first coupling element on the wiper arm and pointing toward the pendulum shaft (88), said support shoulder is located opposite an associated interception shoulder (62), solidly connected to the second coupling element on the wiper blade and pointing away from the pendulum shaft (88), wherein at least one of the two shoulders (44, 46, 68; 62) can be moved counter to a restoring force all the way out of the opposed position relative to the other shoulder (62; 44, 46, 68), wherein both the support shoulder (44, 46, 68) and the interception shoulder (62) have a course that is curved about the pivot axis (54), wherein a respective radius of curvature (70, 76) of the shoulders corresponds to a respective spacing from the pivot axis (54), and further comprising said second coupling element having a base body (48) with spring tongues (58) extending therefrom said spring tongues deflectable substantially in a direction of the pivot axis (54), and wherein the interception shoulder (62) is disposed on a free end of one of said spring tongues.

14. A wiper apparatus for windows of motor vehicles, comprising at least one wiper arm (18), guided on the motor vehicle and driven in pendulum motion, wherein on a free end of the wiper arm, remote from a pendulum shaft (88), a wiper blade (10), elongated transversely to a direction of the pendulum motion (double arrow 86) and capable of being pressed against the window (28), is separably hinged via a connection device (14) that has first and second pivotally connected coupling elements (22 and 16) associated With the wiper arm and the wiper blade, respectively, wherein a pivot axis (54) of the device extends substantially in the pendulum direction, and the wiper apparatus has at least one support shoulder (44, 46; 68), solidly connected to the first coupling element on the wiper arm and pointing toward the pendulum shaft (88), said support shoulder is located opposite an associated interception shoulder (62), solidly connected to the second coupling element on the wiper blade and pointing away from the pendulum shaft (88), wherein at least one of the two shoulders (44, 46, 68; 62) can be moved counter to a restoring force all the way out of the opposed position relative to the other shoulder (62; 44, 46, 68), wherein the first coupling element (22) is generally U-shaped and has two legs (36, 38), wherein one said support shoulder (44, 46, 48) is formed on each of said two legs (36, 38) of the first coupling element (22), wherein said legs of the first coupling element (22) fit over a base body (48) of the second coupling element (16), and wherein a spring tongue (58) is provided on said base body, includes the interception shoulder (62) and is disposed on each of two sides of said base body (48) adjacent the legs of the first coupling element (22).

* * * * *

EXHIBIT B

US006553607B1

(12) United States Patent
De Block

(10) Patent No.: US 6,553,607 B1
(45) Date of Patent: Apr. 29, 2003

(54) **WIPER DEVICE FOR MOTOR VEHICLE WINDOWS**

(75) Inventor: **Peter De Block**, Halen (BE)

(73) Assignee: **Robert Bosch GmbH**, Stuttgart (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/744,481**

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§ 371 (c)(1),
(2), (4) Date: **Apr. 5, 2001**

(87) PCT Pub. No.: **WO00/73113**

PCT Pub. Date: **Dec. 7, 2000**

(30) **Foreign Application Priority Data**

May 28, 1999 (DE) 199 24 662

(51) **Int. Cl.**[7] **B60S 1/40**; B60S 1/38
(52) **U.S. Cl.** **15/250.32**; 15/250.43
(58) **Field of Search** 15/250.32, 250.351, 15/250.44, 250.43, 250.361

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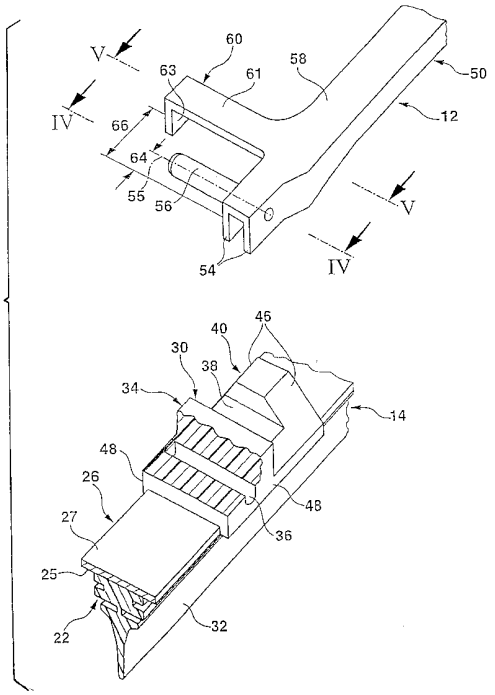
(74) *Attorney, Agent, or Firm*—Michael J. Striker

(57) **ABSTRACT**

A wiper apparatus for motor vehicle windshields is proposed, said apparatus being provided with a driven wiper arm located on the motor vehicle body and movable between reversing positions, on whose free end is fixed one side of a joint pin whose axis extends transverse to the longitudinal axis of the wiper arm and essentially in the direction of movement of the wiper arm. On the joint pin is lodged a wiper blade capable of swinging about the joint axis, the wiper apparatus having means for securing the wiper blade on the joint pin. A particularly cost-effective wiper apparatus is obtained when the securing means for the wiper blade are disposed on the wiper arm and on the side of the wiper blade facing away from said arm cooperate with a stop located on the wiper blade side.

14 Claims, 4 Drawing Sheets



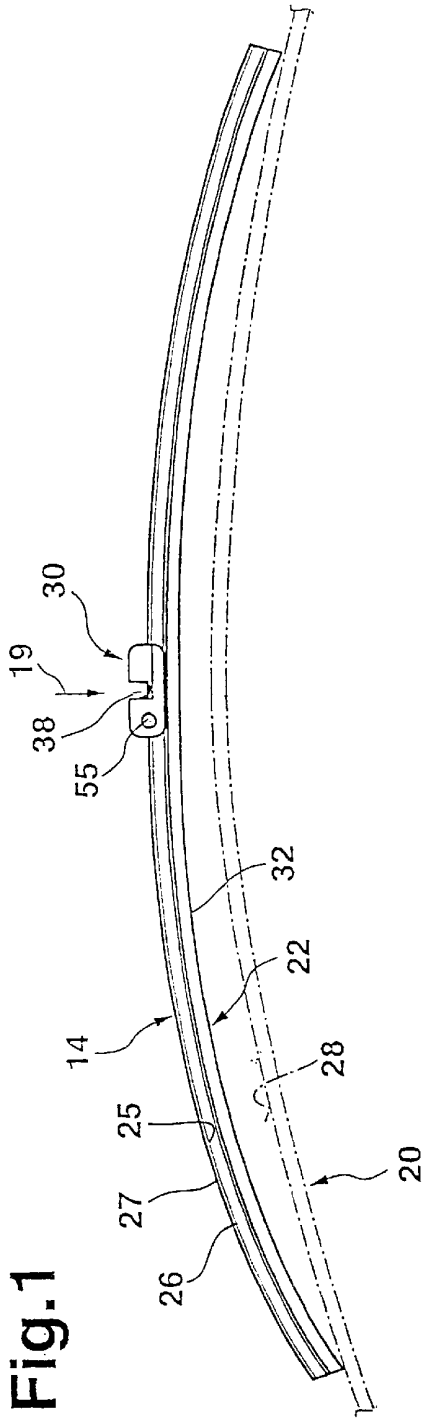


Fig.1

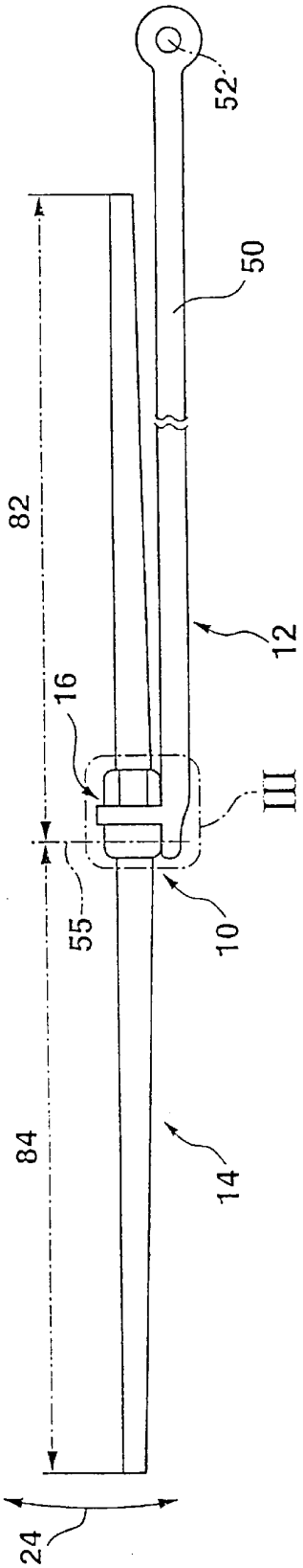


Fig.2

Fig.3

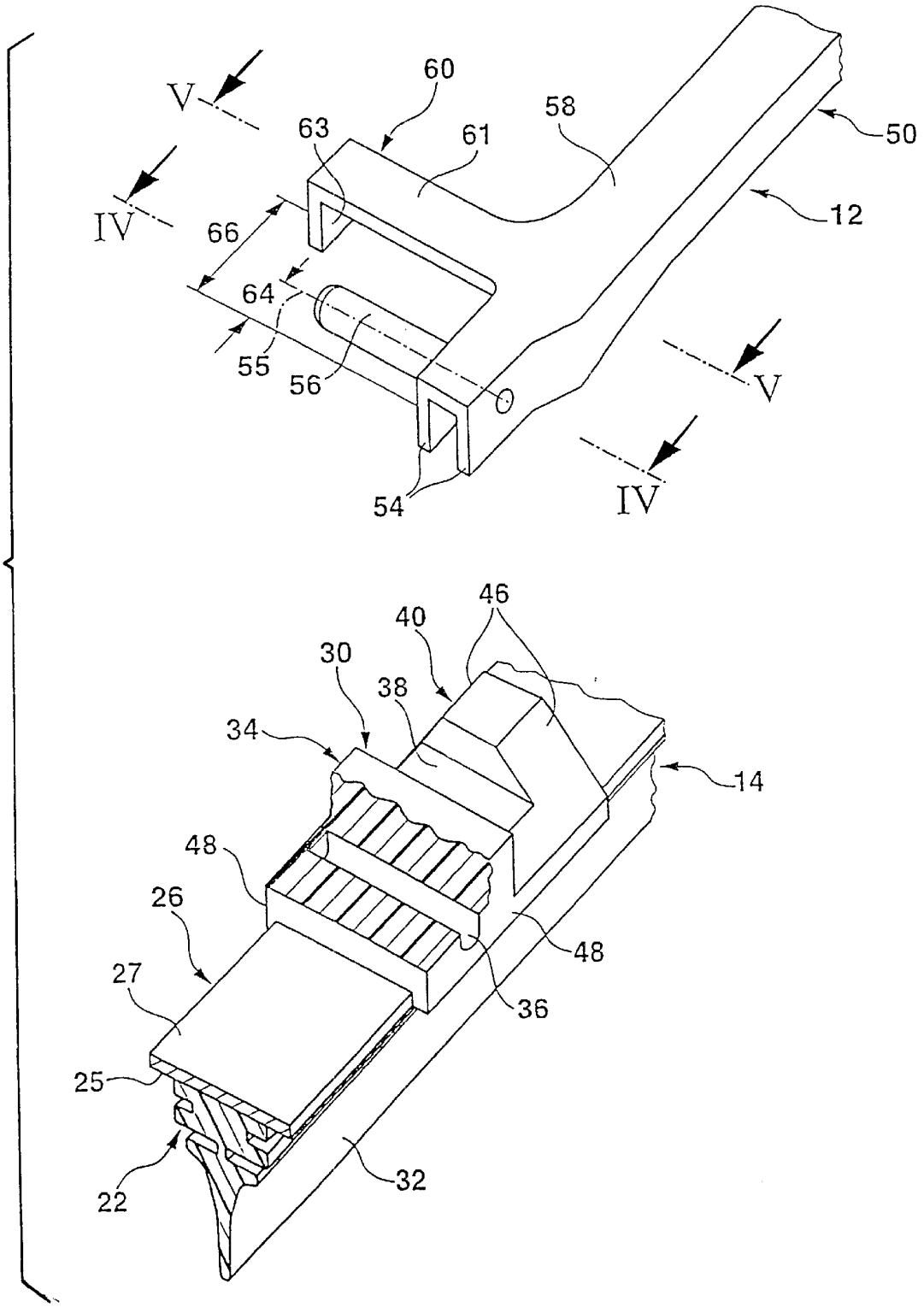

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Fig.4

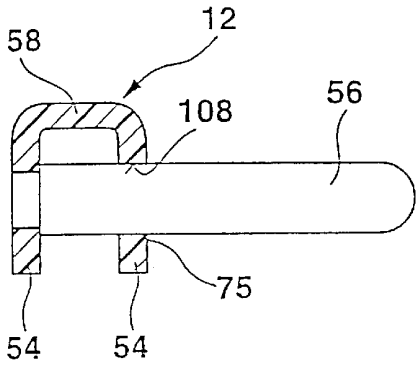


Fig.5

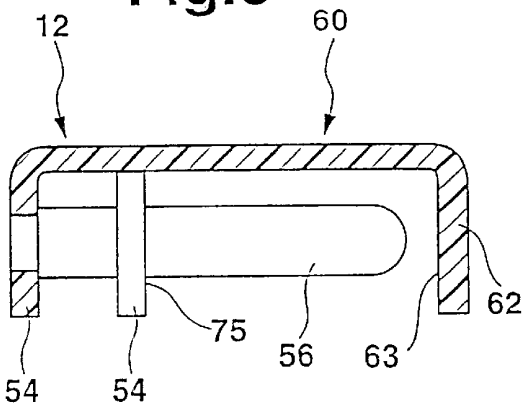


Fig.6

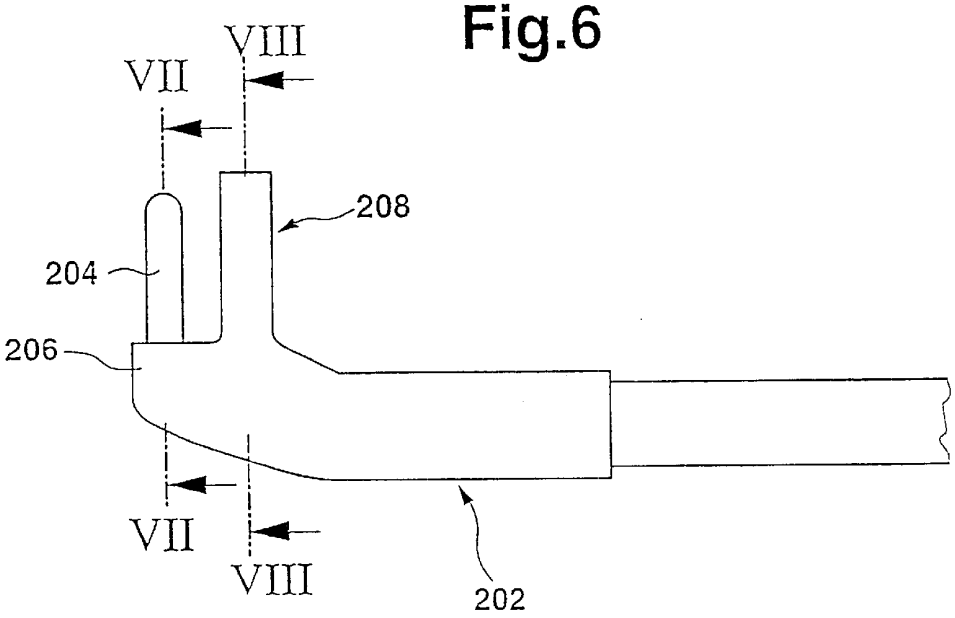


Fig.7

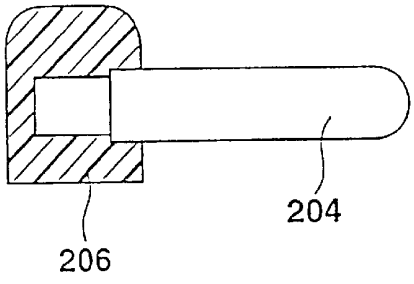


Fig.8

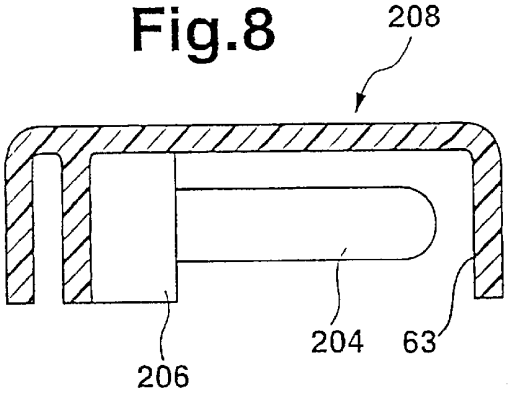


Fig. 9

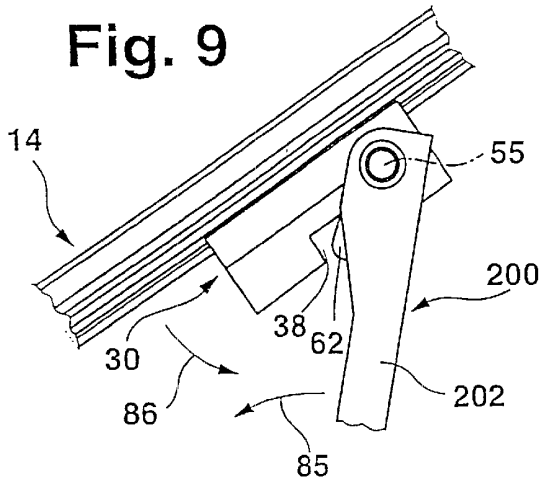


Fig. 10

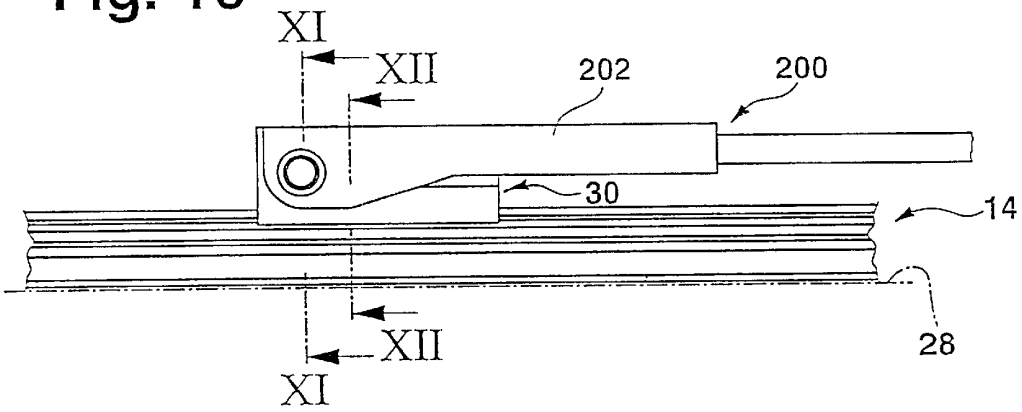


Fig. 11

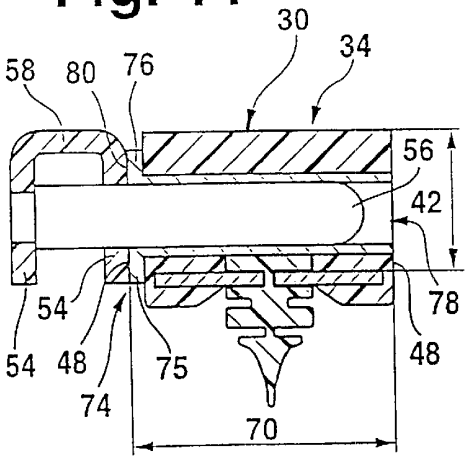
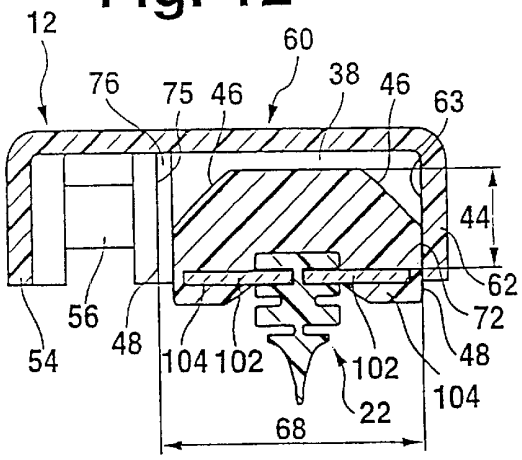


Fig. 12



WIPER DEVICE FOR MOTOR VEHICLE WINDOWS

BACKGROUND OF THE INVENTION

The invention relates to a wiper apparatus. In a known wiper of this kind (DE 16 55 41 0 A1), the wiper arm and the wiper blade are disposed next to each other as viewed in the direction of the windshield to be wiped and one after the other as seen in the working direction of the wiper apparatus. In this manner, it is possible to achieve a lower overall height for the wiper apparatus than can be done for wipers in which the wiper arm is located over the wiper blade (DE 15 05 397 A1). The lower overall height of the wiper apparatus of this type is advantageous in terms of the lift-off of the wiper blade from the windshield, particularly at high travel velocities.

To ensure that the wiper blade is securely fastened by the joint pin during the wiping operation, in the known wiper arrangement the joint pin, which is disposed laterally on the wiper arm, is provided in its center portion with a ring groove into which, after the wiper blade is mounted on the joint pin, a leaf spring fits at one end, said leaf spring being capable of being deflected by a force and, together with the ring groove side walls, of securely fastening the wiper blade on the wiper arm. The arrangement and configuration of such securing means is cost-intensive because, on the one hand, the joint pin must be provided with a ring groove and, on the other, when the wiper blade is replaced, the new wiper blade must be provided with an appropriate leaf spring.

In another known wiper apparatus (DE 26 40 399 A1), the joint pin and the securing means formed by a hinged bracket are disposed on the same structural component of the wiper apparatus. Because this component is the wiper blade, however, when said blade has to be replaced, both the joint pin and the hinged bracket are lost.

SUMMARY OF THE INVENTION

In the wiper apparatus according to the invention, both the securing means and the joint pin are retained when the wiper blade is replaced. The securing means on the wiper blade side—namely the stop—can be formed by the corresponding side cheek of the wiper blade which is always present and which faces away from the wiper arm. This side cheek does not need to have a special configuration.

A wiper apparatus of particularly low design and thus flow-promoting is obtained when the wiper blade has a strip-shaped, elongated carrying element, made of an elastic material, for a wiping strip that comes in contact with the windshield to be wiped, on whose strip surface which faces away from the windshield is disposed a coupling part belonging to a connecting device and having a bearing recess for the joint pin.

In the configuration of the invention, the securing means of the wiper arm are formed by support regions which in the wiping direction are disposed at a distance from each other and are oriented toward each other, and between which are disposed matching regions of the wiper blade, said matching regions facing away from one another. A cost-effective realization of the inventive idea is attained in this manner.

A particularly robust and thus reliably operating wiper apparatus is obtained when one support region is disposed on a swiveling lever of the wiper arm and the swiveling lever has a shoulder which projects out in the direction of the joint axis and across the wiper blade and at the free end of which

is disposed a leg facing the windshield, the side of said leg facing the swiveling lever forming the other support region.

To limit the length of the wiper blade to the required size, the distance from the free end of the wiper arm to the joint axis is smaller than the distance from the free end of the wiper arm to the shoulder.

According to a further development of the invention, viewed in the longitudinal direction the bearing bore is disposed in the coupling part near one end of the same and, furthermore, the coupling part is lower, at least in the region of the shoulder and relative to the carrying element, than in the region of the bearing bore. In other words, the shoulder can be located where the coupling part is lower so that, as a result of the arrangement of the shoulder in the transverse region, the overall height does not need to be increased. The stability of the coupling part in the region of the highly stressed bearing bore is thereby not impaired.

Advantageously, this low region of the coupling part is attained by providing said part in the region of the shoulder disposed on the wiper arm with a groove open at the top and facing away from the carrying element and in which the shoulder crosses the coupling part.

When the wiper arm together with the wiper blade must be moved away from the windshield, for example to replace the wiper blade, an uncontrolled separation of the wiper blade from the wiper arm can be prevented by making the distance, in the longitudinal direction of the wiper blade, from the bearing bore over the transverse groove to one end of the wiper blade greater than to the other end of the wiper blade. In this manner, because the center of gravity has been displaced, the half of the wiper blade lying next to the wiper arm is turned toward the shoulder so that the wiper blade comes to rest by itself between the leg of the shoulder and the wiper arm or the swiveling lever thereof where it is secured. Inadvertent separation of the wiper blade from the wiper arm is thus not possible, because for this to happen, the wiper blade would have to be turned toward the wiper arm so as to displace it from the securing region of the leg.

A particularly simple configuration of the matching regions of the wiper blade is obtained when said regions are formed on the two long sides of the coupling part that face one another.

To minimize lateral play between the wiper blade and the support regions of the wiper arm, the distance, measured in the direction of the joint axis, between the matching regions of the wiper blade is adapted to the distance between the support regions of the wiper arm, because in this manner the side walls of the groove absorb at least part of the forces acting on the wiper blade—forces that can arise, for example, as a result of uneven soiling of the windshield—and thus relieve the load from the joint pin or the bearing pin.

Facilitated guidance of the wiper blade and thus a particularly quiet wiping operation can be achieved when, measured in the longitudinal direction of the wiper blade, the width of the shoulder is adapted to the width of the groove.

For a wiper blade which at least in the region of the joint pin has a U-shaped cross-section, whose U-leg faces the windshield, the joint pin can be fastened in simple manner by making said pin pass through the U-leg in a recess in proximity to the wiper blade and fastening said pin on the other U-leg.

Advantages for the bearing position of the wiper apparatus can arise when a separate connecting piece is fastened at the free end of the wiper arm or swiveling lever, said connecting piece being provided with both the joint pin and the securing means for the wiper blade.

When the wiper arm or the swiveling lever thereof are in the form of an injection-molded part, the joint pin can be connected with the wiper blade or the swiveling lever in simple fashion by molding one of its ends to the wiper blade.

Other advantageous features and embodiments of the invention are indicated in the following description of the embodiment examples shown in the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings,

FIG. **1** shows a side view of the wiper blade belonging to the wiper apparatus of the invention;

FIG. **2** shows a top view of the wiper apparatus with the wiper blade according to FIG. **1**;

FIG. **3** is a representation in perspective of a magnified detail of the wiper apparatus of FIG. **2**, indicated by III;

FIG. **4** shows a section through the wiper blade of FIG. **3** along line IV—IV, appropriately turned;

FIG. **5** shows a section through the wiper arm of FIG. **3** along line V—V, appropriately turned;

FIG. **6** shows a top view of the injection-molded free end of a possible embodiment of the wiper arm;

FIG. **7** shows a section through the wiper arm of FIG. **6** along line VII—VII, appropriately turned;

FIG. **8** shows a section through the wiper arm of FIG. **6** along line VIII—VIII, appropriately turned;

FIG. **9** is a partial representation, not to scale, of the wiper arm connected with the wiper blade wherein the wiper arm together with the wiper blade is pushed into a mounting position away from the windshield;

FIG. **10** shows the arrangement of FIG. **9** in operating position;

FIG. **11** shows a magnified representation of a section through the wiper apparatus of FIG. **10** along line XI—XI, and

FIG. **12** shows a magnified representation of a section through the wiper apparatus of FIG. **10** along line XII—XII.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A wiper apparatus **10** for motor vehicle windshields, shown in FIG. **2**, comprises a driven wiper arm **12** located on the motor vehicle body, with a wiper blade **14** linked to its free end. The articulated linkage between wiper arm **12** and wiper blade **14** consists of an appropriately made connecting device **16**. Wiper arm **12** and thus also wiper blade **14** are stressed in the direction of arrow **18** [sic—"arrow **18**" is not shown in the drawing—Translator] toward a motor vehicle windshield **20**, indicated in FIG. **1** by a dash-dot line, with which an elongated, elastic wiping strip **22** can be brought in contact. In the resulting operating position, the wiper blade is displaced over the windshield in the direction of the double arrow **24** (FIG. **2**) to clean the surface **28** thereof. In FIG. **1**, however, wiper blade **14** is shown in a position in which only its two ends touch windshield **20**. Wiping strip **22** of wiper blade **14** is disposed parallel to the longitudinal axis on the side of strip **25**, facing windshield **20**, of a one-part strip-like carrying element **26**. On the other side of strip **27** of carrying element **26**, facing away from windshield **20**, is fastened on the wiper blade side, in the center portion thereof, a device part **30** belonging to connecting device **16**. As can be seen from FIG. **1**, the wiper blade in its represented position in which it does not yet touch windshield **20** in its entire length is more strongly curved than is the windshield. Because FIG. **1** shows the strongest curvature of windshield surface **28**, it is clearly evident that the curvature of wiper blade **14** touching windshield **20** with both its ends is greater than the maximum windshield curvature. Under the applied pressure (arrow **18**), the wiper blade along its entire length touches with its wiping lip **32** the windshield surface **28** to be wiped. This produces in the elastic carrying element **26** a tension which provides for appropriate contact between the entire length of wiping strip **22**, or of wiping lip **32**, and windshield **20**. Because the windshield, which normally is curved in spherical fashion, is not a segment of a spherical surface, wiper blade **14**, unlike wiper arm **12**, must at all times during its wiping motion (double arrow **24**) be able to adapt itself to the particular position of the windshield. For this reason, connecting device **15** [sic—"connecting device **16**" seems to be meant—Translator] is designed also as an articulated connection between wiper blade **14** and wiper arm **12**.

In the following, two embodiment examples of the connection between the wiper blade and the wiper arm will be described in greater detail. As can be seen from FIG. **3**, wiper blade **14** is provided with a one-part, strip-like carrying element **26**. In the center portion of the wiper blade shown here is located on the side of the wiper blade the device part, or coupling part, **30** with the aid of which wiper arm **12** can be connected with wiper blade **14** in an articulated manner. Device part **30** which in this embodiment example is made of plastic is rigidly connected with the wiper blade or the carrying element **26** thereof. It has a block-shaped section **34** in which is disposed a bearing bore **36** in the form of a blind hole. Bearing bore **36** is located in the block-shaped section **34** of the connecting part, near one of the longitudinal ends thereof. At the other longitudinal end is connected to section **34** of device part **30** a groove **38** oriented transverse to the longitudinal direction of wiper blade **14**, said groove at its top being open toward the side facing away from carrying element **26**. End section **40**, which toward the other end of device part **30** is in the proximity of cross groove **38**, is also shaped like a block, but is not as high as section **26** with bearing bore **36**. From this it follows that the height of section **34** of device part **30** is the greatest relative to the upper side **27** of carrying element **26**. In FIG. **11**, this height is indicated by reference number **42**. The height of device part **30** is smallest in the region of cross groove **38** or of the groove bottom. This height is indicated in FIG. **12** by reference number **44**. The height of section **40** corresponds to height **42** of section **34** in the embodiment example. It is also quite possible to retain height **44** from the groove region over section **40** of device part **30** so that instead of groove **38** a shoulder is formed. Moreover, device part **30** is provided in the region of its section **40** beyond cross groove **38** with inclined surfaces **46**. Inclined surfaces **46**, however, are sized so that side cheeks **48** are retained over the entire length of device part **30** on both of its longitudinal sides which face each other and which extend from section **34** beyond cross groove **38** to the end of section **40** of device part **30** (FIG. **3**).

Moreover, FIG. **3** shows the free end on the connection side of wiper arm **12** which free end in this embodiment is in the form of a non-cutting sheet metal part. It has a swiveling lever **50** extending from a bearing location **52** (FIG. **2**) on the motor vehicle body and has a U-shaped cross-section, at least over large regions. The U-legs **54** of swiveling lever **50** are oriented toward the windshield **20** to be wiped. Close to its free end which is located away from bearing location **52**, the swiveling lever is provided with a joint pin **56** which has a smooth surface and whose axis **55**

extends essentially in the direction of the wiper arm motion (double arrow **24** in FIG. **2**). The diameter of joint pin **56** is adapted to the diameter of the bearing bore **36** in device part **30** in a manner ensuring a virtually play-free, smooth fit which allows an unhindered swinging motion of wiper blade **14** about axis **55** of joint pin **56**. As can also be seen from FIG. **3**, the U-base **58** of swiveling lever **50** extends with an L-shaped shoulder **60** outward beyond one U-leg **54**, the one L-leg **61** connected with U-base **58** being oriented transverse to the extension of swiveling lever **50**. The other L-leg **62** [sic—Translator] is oriented toward windshield **20**. Distance **64** from the free end of wiper blade **12** or swiveling lever **50** to joint axis **55** is smaller than the distance **66** from the free end of the wiper arm or swiveling lever **50** to the L-shaped shoulder **60**.

When, as in FIG. **3**, wiper blade **14** is to be attached to the connection end of wiper arm **12** (FIG. **3**), wiper arm **200** must first be brought into a position—deflected from windshield **20** in the direction opposite to that of arrow **65** [sic—Translator]—as shown in FIG. **9**. Moreover, as shown in FIG. **9**, wiper blade **14** must then assume the position relative to the wiper arm in which the L-leg **62** of the L-shaped shoulder **60** belonging to wiper arm **12** assumes the position, seen in FIG. **9**, relative to cross groove **38** of the device part **30** belonging to wiper blade **14**. It is necessary to ensure an appropriate adaptation of the distance from the joint axis to the two side walls of the groove on one side to the distance from the joint axis to the side edges of one L-leg **61** connected to swiveling lever **50** of wiper arm **12**. When the mounting position between wiper arm **200** and wiper blade **14**, represented in FIG. **9**, is realized, wiper blade **14** can be pushed in the direction of joint axis **55** onto joint pin **56** of the wiper arm until side cheek **48** presenting the opening of bearing bore **36** touches the wiper arm or a rigid shoulder of the wiper arm. In this intermediate mounting position, wiper blade **14** can be turned relative to wiper arm **200** in the direction of arrow **86** (FIG. **9**) as shown in FIG. **10**. The wiper arm can then also be swung back in the direction of arrow **85** (FIG. **9**) and thus brought into its operating position in which wiper blade **14** closely conforms to the surface **28** of windshield **20** to be wiped (FIG. **10**). The relative movement between the wiper arm and the wiper blade is possible because distance **68** (FIG. **12**) between the inner side of leg **62** facing wiper arm **12** is adapted to a length **70** which on the wiper blade or, in the embodiment example, on device part **30** is measured in the direction of joint axis **55**. Here, the two Measuring sites must not necessarily face each other. In the embodiment example, one measuring region **72** is on the side cheek **48** of device part **30** which when the wiper blade is mounted on the wiper arm is in direct proximity to the inner side of L-leg **62**. The other measuring region **74**, in the embodiment example shown in FIG. **11**, is formed by the collar **76** of a bearing bushing **78** the bore of which takes over the bearing function for joint pin **56** and which, in turn, rests firmly in device part **30**. Here, the front face **80** of collar **76** serves as the reference point for measuring region **74**.

In the configuration of device part **30** according to FIG. **3**, the measuring sites for length **70** are formed by the two long sides or side cheeks **48** of device part **30** itself. It is important that in the operating position of the wiper apparatus shown in FIGS. **11** and **12** the one side cheek **48** of the wiper blade, or the measuring regions **72** and **74** of the wiper blade, faces directly the inner side **63** of L-leg **62** or measuring region **75** for the distance **68** on wiper arm **12**. L-leg **62** or its inner wall **63** facing the wiper arm, together with the measuring site **75** that faces said inner wall, forms on the wiper arm support regions which are located at a distance **68** from one another in the wiping direction and are oriented toward one another. Between these support regions **63** and **75** of the wiper arm lie matching regions **72**, **74** of the wiper blade, said regions facing away from one another and being formed by the front face **80** of collar **76** or on the side cheeks **48** of device part **30**.

It can be seen from FIGS. **2** and **3** that, measured in the longitudinal direction of wiper blade **14**, the distance **82** of the bearing bore or of the joint axis **55** over the cross groove **38** to one end of the wiper blade is greater than the distance **84** from joint axis **55** to the other end of the wiper blade. Because the center of gravity is thus fixed and displaced toward one end of the wiper blade, when the wiping apparatus **10** swings away from windshield **20** in the direction opposite to arrow **85** in FIG. **9**, a moment is created which turns the wiper blade about the joint axis **55** in the direction of arrow **86** so that said blade with the side cheeks **48** of device part **30** always remains between the securing means **63**, **75** of wiper arm **1 2** and is thus protected against inadvertent separation of the wiper arm.

The necessarily specified operating location of wiper blade **14** between the securing means of the wiper arm avoids erroneous mounting with certainty, because otherwise the visually clearly recognizable operating position between wiper arm and wiper blade cannot be attained.

The use of bearing bushing **78** in place of blind hole **36** shown in FIG. **3** has advantages in terms of the adaptation of the sliding partners.

Note regarding the configuration according to FIGS. **11** and **12** that here the wiper blade is not provided with a one-piece carrying element, but that said element consists of two part rails **102** which rest in longitudinal grooves **104** of wiping strip **106** [sic—Translator]. Part rails **102** are secured in their longitudinal grooves **104** by the fact that device part **30** overlaps and grips from below in claw-like fashion the longitudinal edges of the part rails, which rails face away from each other. Moreover, FIGS. **4**, **5**, **11** and **12** show that in a wiper arm **12** made of sheet metal and having a U-shaped cross-section whose U-leg **54** is oriented toward windshield **20**, joint pin **56** passes through the U-leg **54** in a recess **108** in proximity to wiper blade **14** and is fastened, preferably riveted or welded, to the other U-leg **54**.

In another embodiment of the wiper arm **12** shown in FIGS. **6** to **10**, said arm is provided at its free end with a separate connecting piece **202** made by casting or injection-molding, which has both joint pin **204** and securing part **208** for the wiper blade. In this case, the joint pin is molded to the massive end piece **206** of the wiper arm. In this embodiment, it is clear that the L-shaped shoulder **208** is molded directly onto connecting piece **202**. The arrangement and configuration of joint pin **204** and of the L-shaped shoulder **208** per se and relative to one another are entirely equivalent to the embodiment of the invention explained by reference to FIGS. **3** and **12**.

To improve the guidance of the wiper blade on the wiper arm and to reduce the load on bearing means **36** or **56** of the wiper arm and the wiper blade, it may be advantageous to fittingly adapt to each other the width of one L-leg **61**, measured in the longitudinal direction of the wiper arm, and the width of cross groove **38**.

The two embodiment examples have in common the feature that the securing means for wiper blade **14** are disposed on wiper arm **12** and that on the side of the wiper blade facing away from the wiper arm said means cooperate with a stop on the wiper blade side, said stop being formed

by the inner wall of the other L-leg **62**. It is clear that the securing of the wiper blade on the joint pin toward the other side is taken over by the wiper arm itself, because the joint pin is fastened to this wiper arm.

What is claimed is:

1. Wiper apparatus **(10)** for motor vehicle windshields, with an elongated driven wiper arm **(12)** located on a motor vehicle body, movable between reversing positions, on a free end of said arm is fixed on one end of a cantilevered joint pin **(56)** with a joint axis **(55)** extending transverse to the longitudinal axis of the wiper arm and essentially in the direction of movement of the wiper arm, on said joint pin being mounted a wiper blade **(14)** capable of swinging about the joint axis **(55)**, said blade having spaced sides with said arm lying on one of said sides the wiper apparatus having means for securing the wiper blade on the joint pin **(56)**, characterized in that the securing means **(60)** are disposed on the wiper arm **(12)** and extending therefrom and that on the other side of the wiper blade **(14)** facing away from said wiper arm said means cooperate with a stop **(62, 63)** located on the other side of the wiper blade.

2. Wiper apparatus according to claim **1**, characterized in that the wiper blade **(14)** has a strip-shaped, elongated carrying element **(26)**, made of an elastic material, for a wiping strip **(22)** coming in contact with the windshield **(20)** to be wiped, on whose strip-like surface **(27)** facing away from the windshield is disposed a coupling part **(30)** belonging to a connecting device **(16)** and having a bearing recess **(36)** for the joint pin **(56)**.

3. Wiper apparatus according to claim **1**, characterized in that the securing means **(63, 75)** of the wiper arm **(12)** are formed by supporting regions **(62, 75)** located on said arm and disposed in the wiping direction (double arrow **24**) at a distance from one another and oriented toward each other, between which regions are disposed matching regions **(48** or **80)** of the wiper blade **(14)** which face away from each other.

4. Wiper apparatus according to claim **3**, characterized in that one supporting region **(75)** is disposed on a swiveling lever **(50)** of the wiper arm **(12)** and that the swiveling lever has a shoulder **(60)** which projects in the direction of the extension of the joint axis **(55)** and which crosses the wiper blade, on the free end of said shoulder being disposed a leg **(62)** oriented toward the windshield, the side **(63)** of said leg that faces the swiveling lever forming the other supporting region.

5. Wiper apparatus according to claim **4**, characterized in that the distance **(64)** from the free end of the wiper arm to the joint axis is less than the distance **(66)** from the free end of the wiper arm to the shoulder **(60)**.

6. Wiper apparatus according to claim **5**, characterized in that, seen in the longitudinal direction of the wiper blade **(14)**, the bearing bore **(36)** is disposed in the coupling part **(30)** near one end thereof and that, at least in the region of the shoulder **(60)** and relative to the carrying element **(26)**, the coupling part is lower than in the region of the bearing bore **(38)**.

7. Wiper apparatus according to claim **6**, characterized in that the coupling part **(30)** in the region of the shoulder **(60)** disposed on the wiper arm is provided with a cross groove **(38)** having an upper side that faces away from the carrying element **(26)** and in which groove the shoulder **(60)** crosses the coupling part **(30)**.

8. Wiper apparatus according to claim **7**, characterized in that, measured in the longitudinal direction of the wiper blade **(14)**, the distance **(82)** of the bearing bore **(36)** over the cross groove **(38)** to one end of the wiper blade **(14)** is greater than the distance to the other end of the wiper blade.

9. Wiper apparatus according to claim **7**, characterized in that the matching regions **(72, 74)** of the wiper blade **(14)** are formed on the two mutually facing longitudinal sides **(48)** of the coupling part **(30)**.

10. Wiper apparatus according to claim **9**, characterized in that, measured in the direction of the joint axis **(55)**, the distance **(70)** between the matching regions of the wiper blade is adapted to the distance **(68)** between the supporting regions **(63, 75)** of the wiper arm.

11. Wiper apparatus according to claim **7**, characterized in that, measured in the longitudinal direction of the wiper blade, the width of the shoulder **(60)** is adapted to the width of the cross groove **(38)**.

12. Wiper apparatus according to claim **1**, characterized in that, at least in the region of the joint pin **(56)**, the wiper arm has a U-shaped cross-section, whose U-legs **(54)** are oriented toward the windshield **(20)**, and that the joint pin **(56)** passes through the U-leg in a recess **(108)** in proximity to the wiper blade and is fastened to the other U-leg **(54)**.

13. Wiper apparatus according to claim **1**, characterized in that at least one section **(202)** of the wiper arm **(200)** is a part made by injection molding and that the joint pin **(204)** at said one end is molded to the wiper arm.

14. Wiper apparatus according to claim **1**, characterized in that a separate connection piece **(202)** is attached to the free end of the wiper arm, said connection piece having both the joint pin **(204)** and the securing means **(208)** for the wiper blade **(14)**.

* * * * *

EXHIBIT C

US006611988B1

(12) **United States Patent**
De Block

(10) **Patent No.: US 6,611,988 B1**
(45) **Date of Patent: Sep. 2, 2003**

(54) **WIPER BLADE FOR THE GLASS SURFACES OF A MOTOR VEHICLE**

(75) Inventor: **Peter De Block**, Halen (BE)

(73) Assignee: **Robert Bosch GmbH**, Stuttgart (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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§ 371 (c)(1),
(2), (4) Date: **May 14, 2001**

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PCT Pub. Date: **Dec. 7, 2000**

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Aug. 13, 1999 (DE) 199 38 400

(51) **Int. Cl.**[7] **B60S 1/40**; B60S 1/38

(52) **U.S. Cl.** **15/250.32**; 15/250.43; 15/250.351

(58) **Field of Search** 15/250.32, 250.43, 15/250.44, 250.37, 250.361, 250.351

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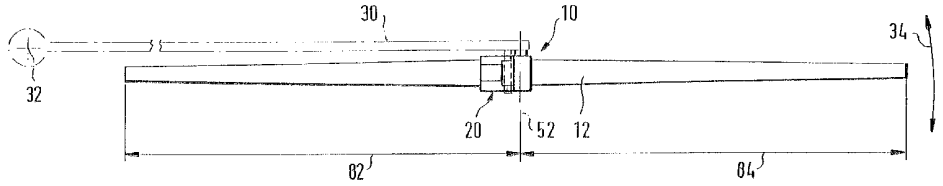
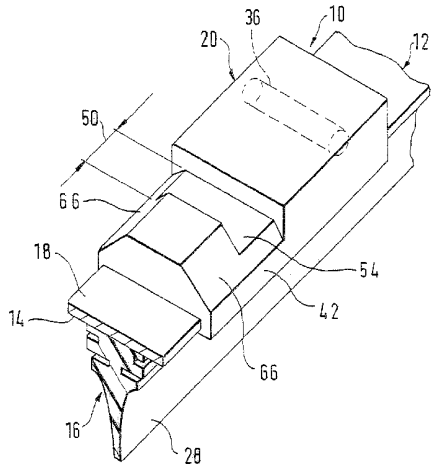
(57) **ABSTRACT**

A wiper blade is proposed, which is used for cleaning motor vehicle windows or glass. The wiper blade **(10)** is provided with an elongated, rubber-elastic wiper strip **(16)** that can be pressed against the window or glass **(24)** and that is disposed, parallel to the longitudinal axis, on one band face **(14)** of a bandlike-elongated, spring-elastic support element **(12)**, and a coupling part **(20)** connected to the center portion of the support element is seated on the other band face **(18)** of the support element and has one hinge half **(36)**, whose hinge axis **(52)** is oriented transversely to the length of the wiper blade **(10)**. An improvement in wiper blade mounting and in the securing of the mounted wiper blade to a wiper arm provided with a hinge bolt is attained, if both this hinge half and the coupling means of the wiper blade are formed by a bearing recess **(36)** in the coupling part **(20)**.

15 Claims, 3 Drawing Sheets





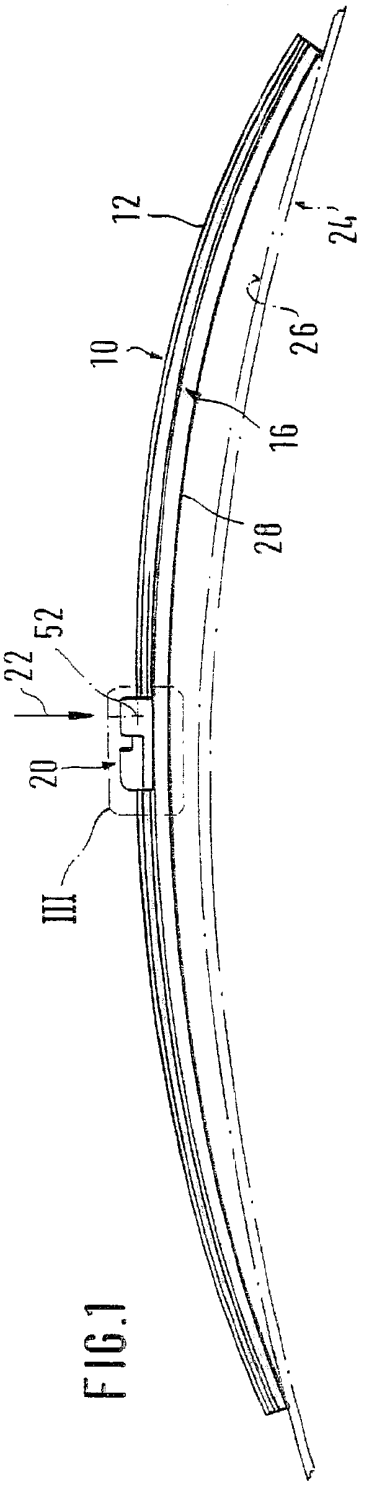


FIG. 1

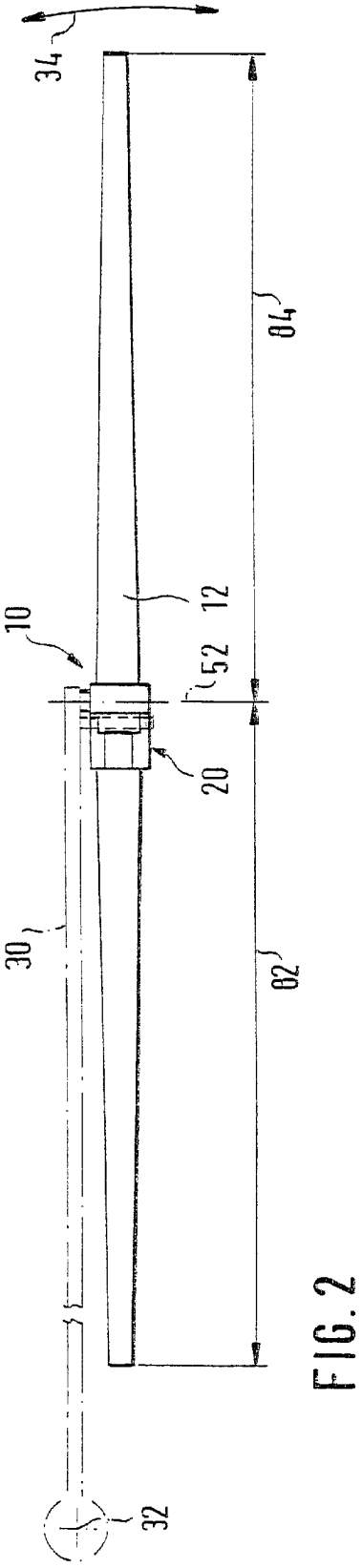


FIG. 2

FIG.3

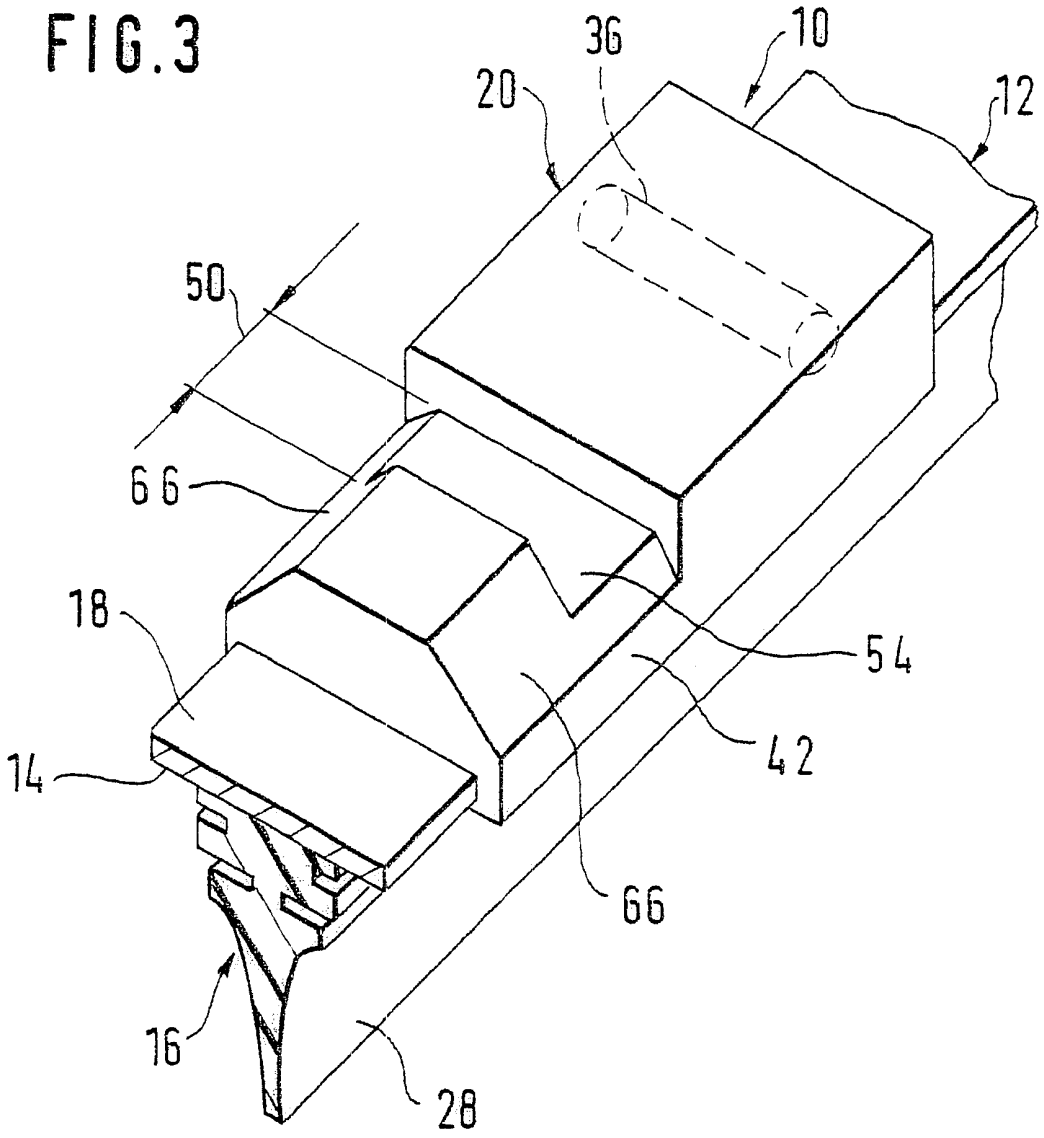


FIG. 4

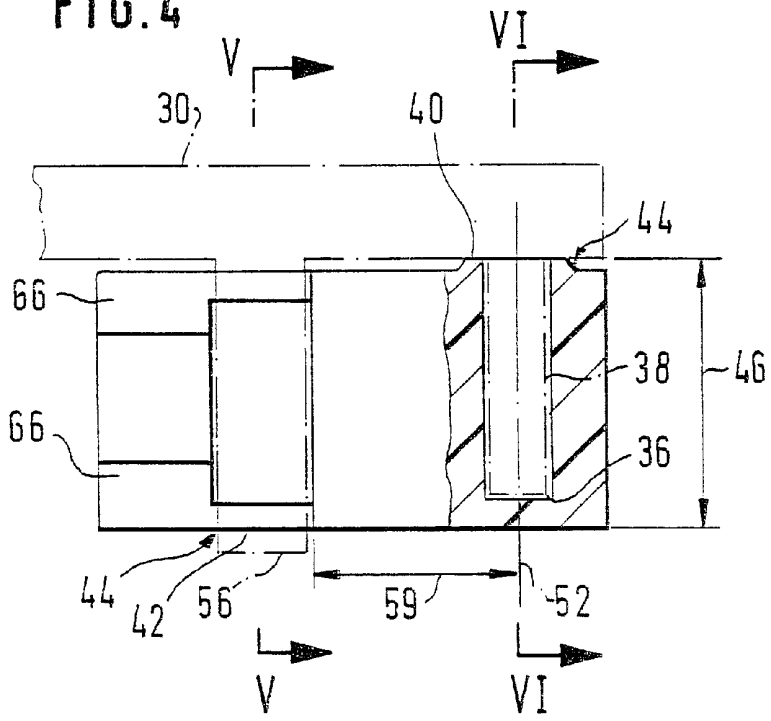


FIG. 6

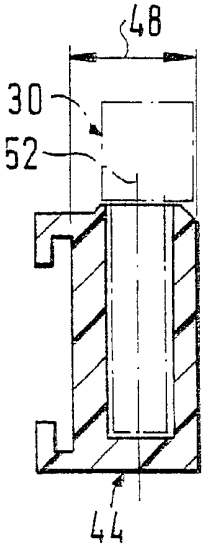


FIG. 5

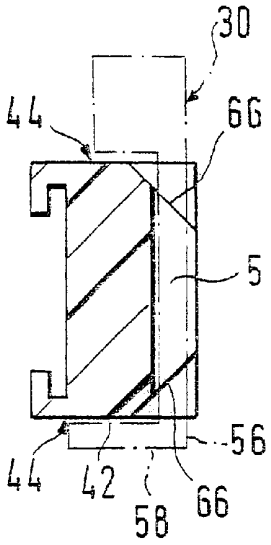
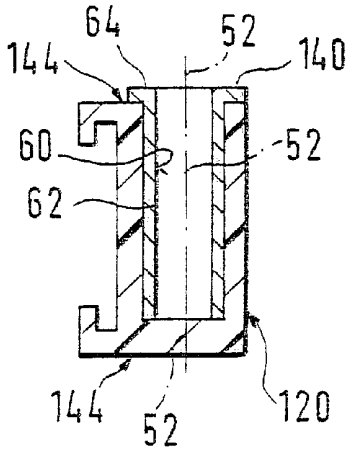


FIG. 7



WIPER BLADE FOR THE GLASS SURFACES OF A MOTOR VEHICLE

BACKGROUND OF THE INVENTION

The support bracket frame wiper blades that have been in long, widespread use in wiping systems for motor vehicle windshields (German Patent DE-PS 15 05 397) have a great structural height, which under the flow conditions prevailing in front of the vehicle window, especially at a high travel speed, enhance the tendency of the wiper blade to lift away. At the least, this lessens the prescribed contact pressure of the wiper blade on the window so much that the wiping quality suffers as a result.

The invention is based on a very shallow wiper blade. In a known wiper blade of this type (German Patent Disclosure DE 19 72 98 65.6 A1), one hinge pin of nonround cross section is disposed on each of the two long sides of the coupling part, and the two hinge pins have a common hinge axis. The hinge half toward the wiper blade that is thus formed cooperates with bearing bores on the wiper arm that form the hinge half of the wiper arm; the bearing bores are each open at the periphery via an introduction channel, and the channel width is adapted to the smaller pin diameter. The design of the hinge is such that during wiper operation, the hinge pins cannot move out of their bearing bores. If the wiper blade is to be removed from the wiper arm, for instance if a worn wiper blade is to be replaced by a new one, then first the wiper arm has to be folded out of the way of the window or glass, so that the wiper blade can be put into its mounting, position, In which the hinge pin can be passed through the insertion channels and the wiper blade can be separated from the arm. If this is done improperly, however, the wiper blade can on route by itself in the hinge even while the arm is being folded out of the way, and thus the blade can separate from the wiper arm unintentionally and drop onto the vehicle body and cause damage there.

SUMMARY OF THE INVENTION

In the wiper blade according to the invention, it is possible to equip the wiper arm with a pin of round cross section, which can be introduced into the bearing recess in the direction of the hinge axis. The result is a coupling and hinge system in which the hinge bolt of the wiper arm is completely surrounded by the bearing recess of the wiper blade. The release of the wiper blade from the wiper arm is accomplished by pulling the wiper blade off the bearing bolt of the wiper arm in the direction of the hinge axis, any securing means that may be present must have been released beforehand. The embodiment of the hinge half toward the wiper blade and of the coupling means is especially advantageously employed in wiping systems in which the wiper arm blade and of the coupling means is especially advantageously employed in wiping systems in which the wiper arm and the wiper blade are disposed one behind the other in terms of the wiping direction. The embodiment of the wiper blade In the region of the coupling part is especially economical, which is significant in terms of the pricing of replacement wiper blades. Besides its function as a coupling means and as a hinge half, the opportunity also exists of using the bearing recess as an excellent positioning aid, when the wiper blade is passing through mounting or test systems during its production. For smooth wiper operation, it is of essential significance that the wiper arm coupling part has two cheek regions, extending in the longitudinal direction of the wiper blade and disposed upright relative to the window or glass, by each of which one cheek region is formed on one of the two long sides of the coupling part, and furthermore the spacing between the two cheek regions is between 16 NM and 25 NM. If guide or fitting faces that are defined once and for all result, against which counterpart faces of the wiper arm can be placed cleanly during wiping operation, so that a good outcome of wiping is assured. Because of the spacing range, measured in the wiping direction, of 16 mm to 25 mm, at the greatest dimension a minimization of any tilting motion of the wiper blade about its longitudinal axis is achieved when the wiper blade reverses Its wiping direction, which if the play is great can also be associated with a certain undesired noise production. On the other hand, the width of the wiper blade measured in the wiping direction must be not exceed a certain size, for styling reasons.

In practice it has been found that these problems are solved especially well if the spacing between the two cheek regions is between 20 mm and 23 mm.

For a special binding situation, a spacing of 22 mm, measured in the wiping direction, between the two cheek regions has proved extraordinarily favorable.

Especially for reasons of appearance, it is especially advantageous if the ratio between the length of the wiper blade and the spacing between the cheek regions is between the values of 1:22 and 1:33.

In a continuation of the concept of the invention, in terms of the longitudinal direction of the wiper blade, the bearing recess is disposed near one end of the coupling part, and the thickness of the coupling part between the one end region provided with the bearing recess and the other end of the coupling part is less, at least over a longitudinal portion, than the end portion of the coupling part that has the bearing recess. The thicker end of the coupling part that has the bearing recess assures the requisite stability in the region where the force is transmitted from the wiper arm to the wiper blade.

To secure the wiper blade against unintended release from the wiper arm even in a position folded away from the window or glass, measured in the longitudinal direction of the wiper blade, the spacing from the transverse bore via the transverse groove to one end of the wiper blade is greater than to the other end of the wiper blade.

If the longitudinal portion of the coupling part that has the lesser thickness is formed by a transverse groove in the coupling part that is open toward the side of the coupling part remote from the support element. This longitudinal portion can be used as a transitional channel for securing means of the wiper arm, which are operative, when the wiper blade is disposed next to the wiper arm in the wiping direction, on the side of the wiper blade remote from the wiper arm, yet without unfavorably affecting the low structural height of the wiper blade.

It has proved to be especially advantageous if one of the two cheek regions surrounds the orifice of the bearing recess, and that the other cheek region is disposed on the portion of the coupling part that has a lesser thickness than the end region of the coupling part that is provided with the bearing recess. The result, seen in the longitudinal direction of the wiper blade, is accordingly a spacing between the two fitting faces that has proved especially advantageous in terms of wiper blade guidance during wiping operation.

If the bearing recess is embodied as a blind bore, then soiling of this bearing point, which suffers high stress, can be reduced considerably.

If the aforementioned securing means of the wiper blade are adapted to the selected width of the groove of 8 mm to

10 mm, preferably 9 mm, the result for the wiper blade during wiping operation is a further improvement in stability as well as relief of the bearing point, when the securing means are braced on the groove walls that face one another.

In order for a spoiler surface, to be disposed on the wiper blade, to be continued in the region of the coupling part as well, at least one of the two long sides of the coupling part is provided with a chamfer over one portion. If both long sides of the coupling part are provided with a chamfer of this kind, then furthermore a simplification for mounting the wiper blade on the wiper arm can also be attained.

Advantages with regard to production costs for the wiper blade are obtained if the coupling part is made from a plastic.

It can be advantageous the bearing recess in the coupling part by the bore of a guide bush seated in the coupling part, a favorable combination of sliding partners with the material for the hinge bolt can be attained.

Further advantageous refinements and features of the invention are disclosed in the ensuing description of an exemplary embodiment, shown in the associated drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

Shown in the drawing are:

FIG. **1**, a side view of a wiper blade of the invention;

FIG. **2**, a plan view on the wiper blade of FIG. **1**, with the wiper arm indicated by dot—dashed lines;

FIG. **3**, an isometric, enlarged view of a detail marked III in FIG. **1**;

FIG. **4**, in plan view, partly in section, a coupling part shown in FIG. **3**;

FIG. **5**, a section through the coupling part taken along the line V—V of FIG. **4**;

FIG. **6**, a section through the coupling part taken along the line VI—VI of FIG. **4**; and

FIG. **7**, a different version of the embodiment of the coupling part shown in FIG. **6**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The wiper blade **10** shown in FIG. **1** has a bandlike-elongated, spring-elastic support element **12** (FIG. **3**), on whose underside **14** an elongated, rubber-elastic wiper strip **16** is secured parallel to the longitudinal axis. On the top side **18**, remote from the windshield **24**, of the support element **12**, which can also be called a spring rail, the coupling part **20** toward the wiper blade of a connection device is disposed in the middle portion of the support element; with the aid of this connection device, the wiper blade **10** can be pivotably and releasably connected to a driven wiper arm. To that end, the wiper arm is provided on its free end with a part of the connection device that belongs to the wiper arm. The wiper arm and thus also the wiper blade **10** are urged in the direction of the arrow **22** toward the window **24** (indicated by dot-dashed lines in FIG. **1**) to be wiped of a motor vehicle; the surface of this window has been identified by reference numeral **26** in FIG. **1**. Since the line **26** is intended to represent the greatest curvature of the window surface, it is quite apparent that the curvature of the still-unloaded wiper blade **10** resting with both ends on the window **24** is greater than the maximum window curvature (FIG. **1**). Under the contact pressure (arrow **22**), the wiper blade **10** presses over its full length with its wiper lip **28** against the window surface **26**. In the process, a tension builds up in the spring-elastic, metal support element **12** that provides for proper contact of the wiper strip **16**, or wiper lip **28**, over its entire length with the window, as well as a uniform distribution of the contact pressure. A wiper blade designed in this way is considerably shallower than a so-called support bracket frame wiper blade, as already noted at the outset here. The advantages of a wiper blade that is provided with a spring rail **12** instead of a support frame are considered to be especially its invulnerability to the tendencies to lift away from the window, which tendencies are unavoidable in support bracket frame wiper blades of greater height. Since the window, which as a rule is spherically curved, does not represent a portion of a spherical surface, the wiper blade **10** must be constantly capable of adapting to the position of the window surface at the time during its wiping motion with regard to the wiper arm **30**. The connection device is therefore simultaneously embodied as a hinge connection between the wiper blade **10** and the wiper arm **30** (represented in dot-dashed lines in FIG. **2**).

During wiping operation, the wiper arm **30** swings back and forth about a pendulum axis **32** (FIG. **2**), so that transversely to its length, the wiper blade **10** is displaced over the window **24** in the direction of a double arrow **34** shown in FIG. **2**.

The special design of the wiper blade **10** will now be described in further detail. As the drawing shows, the coupling part **20** of the wiper blade is seated in the middle portion of the bandlike-elongated support element **12**, specifically on its upper band face **18** remote from the window. The wiper strip **16** is disposed on the other, lower band face **14**. Regardless of the fact that the support element **12** in the exemplary embodiment is shown as a one-piece spring band, it can also be constructed as needed from a plurality of individual or partial elements. The coupling part **20**, solidly connected to the support element **12**, is provided, near one end region, with a transverse bore **36**, which in the embodiment of FIG. **4** is in the form of a blind bore, and which forms the hinge half toward the wiper blade of a hinge that permits a relative motion between the wiper arm and the wiper blade in a plane perpendicular to the window **24**. The transverse bore **36** accordingly acts as a bearing recess, for instance for a hinge bolt **38** (FIG. **4**), shown in dot-dashed lines, disposed laterally on the wiper arm **30**. Along with its function as a bearing recess for the hinge bolt, the transverse bore **36** also forms the coupling means of the wiper blade, by way of which coupling means the wiper blade **10** can be connected operationally securely to the wiper arm **30**.

The coupling part **20** is provided with two cheek regions **40** and **42**, extending in the longitudinal direction of the wiper blade **10** and disposed perpendicular to the window; one cheek region is disposed on each of the two long sides **44** of the coupling part. The spacing **46** measured in the wiping imp direction (double arrow **34**) between the two cheek regions **40** and **42** has particular significance, as will be addressed hereinafter. One purpose of the cheek regions **40** and **42** is that the wiper blade, in one wiping direction, can be braced with its cheek region **40** on a support face of the wiper arm **30**, while the other cheek region **42** takes on this function in the converse motion of the wiper blade. To assure the least possible tilting motion of the wiper blade about its longitudinal axis at the moment of reversal of the direction of wiping, the greatest possible spacing **46** is desired. On the other hand, an excessive spacing **46** impairs the appearance of the wiper blade or the harmony in front view of the motor vehicle equipped with such a wiper blade. In weighing these two criteria, it has proved advantageous if the spacing **46** between the two cheek regions is between 16 and 25 mm. It has also been found that the ratio between the length of the wiper blade and the spacing **46** between the two cheek regions, also for reasons of appearance, should if at all

possible be in the range between the values of 1:22 and 1:33. To cover a broad range of wiper blades sold, a spacing **46** between the two cheek regions **40** and **42** that is between 20 and 23 mm is thus appropriate. For a particular, special application, a spacing **46** of 22 mm has proved to be, extraordinarily advantageous.

As FIGS. **3** and **4** show, the blind transverse bore **36** that can be called a bearing recess is disposed in the coupling part **20** near one end thereof. In this region (FIG. **6**), the thickness **48** of the coupling part, measured outward from the top side **18** of the coupling part **20**, is greater than in another region of the coupling part. It can be seen especially from FIG. **3** that the coupling part **20** is considerably shallower over a longitudinal portion **50** than in the region of the bearing recess **36**. This longitudinal portion **50** is formed by the width of a transverse groove **54**, which is open toward the side of the coupling part remote from the support element **12**. In the exemplary embodiment, it is of special significance that one region **40** of the two cheek regions **40**, **42** is embodied as a bearing eyelet that protrudes in the direction of the hinge axis **52** and that surrounds the orifice of the transverse bore **36**. The other cheek region **42** is located in the region of the long side **44** of the coupling part where the transverse groove **54** discharges or ends. It is accordingly also located where the coupling part **20** has a lesser thickness than at the end region of the coupling part **20** that is provided with the bearing recess **36**. The width **50** of the transverse groove **54**, measured in the longitudinal direction of the wiper blade, is 9 mm in the exemplary embodiment. The result is a sufficiently wide free space for the transition of a securing hook **56**, connected to and belonging to the wiper arm **30**, which hook fits with a leg **58** bent perpendicular relative to the window and thus fits over the wiper blade **10** in the region of the transverse groove **54** and with its leg **58** cooperates with the cheek region **42**, when the wiper blade executes its working motion. A width of 9 mm for the transverse groove **54** makes a suitably stable embodiment of the securing hook **56** possible; this hook crosses the wiper blade in the transverse groove **54** without thereby unfavorably affecting the structural height of the wiper blade **10**.

The coupling part **20** of FIGS. **3–6** is made from a plastic, and the transverse bore **36** is molded directly into the blocklike coupling part, and the bearing eyelet is formed onto the coupling part.

To optimize the sliding properties between the hinge bolt **38** toward the wiper arm and the wall of the transverse bore **36** that acts as its sliding partner, it can be advantageous if the transverse bore **36** is formed by the central bore **60** of a guide or slide bush **62** that is seated in the coupling part **120**. For the same reason, the guide bush **62** can be provided with an annular collar **64**, which protrudes from the long side **144** of the coupling part oriented toward the wiper arm **30** and which thus instead of the bearing eyelet forms a cheek region **140** that corresponds to the cheek region **40** of the version already described. This is naturally also true whenever a separate annular disk is provided instead of the annular collar. Such an embodiment is shown in FIG. **7**.

Because the bearing bore or transverse bore **36** is disposed at a certain spacing **59** from the transverse groove **54** (FIG. **4**), the result naturally is a corresponding spacing **59** between the two cheek regions **40** and **42**, or **140** and **42**, as a result of which still further improvement in wiper blade guidance is attained.

From FIG. **2** it can be seen that the spacing **82**, measured in the longitudinal direction of the wiper blade **10**, between the transverse or bearing bore **36**, or the hinge axis **52**, via the transverse groove **54** to one end of the wiper blade **10** is greater than the spacing **84** from the hinge axis **52** to the other end of the wiper blade. Because of the thus-defined center of gravity shifted toward one end of the wiper blade, when the wiper blade **10** has been folded away from the window **24** a moment occurs that rotates the wiper blade about the hinge axis **52** in the direction of the arrow **86**, so that this always remains with its cheek regions **40**, **42** of the coupling part **20** between the securing means **30**, **56** of the wiper arm **30** and is thus secured against unintended separation from the wiper arm.

Because the operating position of the wiper blade **10** between the securing means of the wiper arm is specified in compulsory fashion, the blade cannot be installed the wrong way around, since if an attempt is made to do so, the readily visible operating position between the wiper arm and the wiper blade cannot be attained.

In certain applications, the wiper blade **10** can be provided with a so-called spoiler strip, known per se, on the top side **18** of the support element **12**. In such applications, it can be advantageous if at least one of the two long sides **44** or **144** of the coupling part is provided over one portion with a chamfer **66**, which in this portion of the wiper blade takes on the function of the spoiler strip. If both long sides of the coupling part are equipped with a chamfer **66** of this kind, then mounting can furthermore be made easier when the wiper blade **10** is to be connected to the wiper arm.

What is claimed is:

1. A wiper blade for cleaning motor vehicle windows and glass, having an elongated, rubber-elastic wiper strip **(16)** that can be pressed against the window and glass **(24)** and that is disposed, parallel to a longitudinal axis, on one band face **(14)** of a band-shaped-elongated, spring-elastic support element **(12)**, and a coupling part **(20)** connected to a center portion of the support element is seated on another band face **(18)** of the support element and has one hinge half, whose hinge axis **(52)** is oriented transversely to a length of the wiper blade **(10)**, wherein both this hinge half and coupling means of the wiper blade are formed by a bearing recess **(36)** in the coupling part **(20)**, and the coupling part **(20)** is considerably shallower over a longitudinal portion than a longitudinal region of the bearing recess **(36)**, and wherein the longitudinal portion **(50)** is formed by a width of a transverse groove **(54)**.

2. The wiper blade of claim **1**, wherein the wiper arm coupling part **(20)** has two cheek regions **(40** and **42**, and **64)**, extending in a longitudinal direction of the wiper blade **(10)** and disposed upright relative to the window and glass **(24)**, by each of which one cheek region is formed on one of two longitudinal sides **(44)** of the coupling part, and that a spacing **(46)** between the two cheek regions is between 16 mm and 25 mm.

3. The wiper blade of claim **2**, characterized in that the spacing **(46)** between the two cheek regions **(40** and **42)** is between 20 mm and 23 mm.

4. The wiper blade of claim **2** characterized in that the spacing **(46)** between the two cheek regions **(40** and **42)** is 22 mm.

5. The wiper blade of claim **2**, wherein in a ratio between a length of the wiper blade **(10)** and the spacing **(46)** between the cheek regions **(40** and **42)** is between values of 1:22 and 1:33.

6. The wiper blade of claim **2**, wherein one **(40)** of the two cheek regions **(40, 42)** surrounds an orifice of the bearing recess **(36)**, and that the other of the two cheek regions **(42)** is disposed on a portion of the coupling part that has a lesser

thickness than an end region of the coupling part that is provided with the bearing recess **(36)**.

7. The wiper blade of claim **6**, wherein the bearing recess **(36)** is embodied as a blind bore.

8. The wiper blade **1**, wherein at least one of two long sides **(44)** of the coupling part is provided with a chamfer **(66)** over one portion.

9. The wiper blade of claim **1**, wherein the coupling part **(20)** is made from a plastic.

10. The wiper blade of claim **9**, wherein the bearing recess is formed by a bore **(60)** of a guide bush **(62)** seated in the coupling part.

11. A wiper blade for cleaning motor vehicle windows and glass, having an elongated, rubber-elastic wiper strip **(16)** that can be pressed against the window and glass **(24)** and that is disposed, parallel to a longitudinal axis, on one band face **(14)** of a band-shaped-elongated, spring-elastic support element **(12)**, and a coupling part **(20)** connected to a center portion of the support element is seated on another band face **(18)** of the support element and has one hinge half, whose hinge axis **(52)** is oriented transversely to a length of the wiper blade **(10)**, wherein both this hinge half and coupling means of the wiper blade are formed by a bearing recess **(36)** in the coupling part **(20)** and in a longitudinal direction of the wiper blade **(10)**, the bearing recess **(36)** is disposed near one end of the coupling part **(20)**, and that a thickness of the coupling part **(20)** between one end region provided with the bearing recess and another end of the coupling part is less, at least over a longitudinal portion **(50)**, than an end portion of the coupling part that has the bearing recess.

12. The wiper blade of claim **11**, wherein a longitudinal portion is formed by a transverse groove **(54)** in the coupling part **(20)**, the groove **(54)** is open toward a side of the coupling part **(20)** remote from the support element **(12)**.

13. The wiper blade of claim **12**, wherein a width **(54)** of the transverse groove **(50)** is from 8 mm to 10 mm.

14. The wiper blade of claim **12**, wherein the width **(54)** of the transverse groove **(50)** is a 9 mm.

15. A wiper blade for cleaning motor vehicle windows and glass, having an elongated, rubber-elastic wiper strip **(16)** that can be pressed against the window and glass **(24)** and that is disposed, parallel to a longitudinal axis, on one band face **(14)** of a band-shaped-elongated, spring-elastic support element **(12)**, and a coupling part **(20)** connected to a center portion of the support element is seated on another band face **(18)** of the support element and has one hinge half, whose hinge axis **(52)** is oriented transversely to a length of the wiper blade **(10)**, wherein both this hinge half and coupling means of the wiper blade are formed by a bearing recess **(36)** in the coupling part **(20)**, wherein measured in a longitudinal direction of the wiper blade **(10)**, the spacing **(82)** from the bearing recess **(36)** via a transverse groove **(54)** to one end of the wiper blade **(10)** is greater than the spacing **(84)** to another end of the wiper blade.

* * * * *

EXHIBIT D

US006675434B1

(12) **United States Patent**
Wilhelm et al.

(10) **Patent No.: US 6,675,434 B1**
(45) **Date of Patent: Jan. 13, 2004**

(54) **WIPER BLADE FOR THE GLASS SURFACES OF MOTOR VEHICLES WITH AN ELONGATED, SPRING-ELASTIC SUPPORT ELEMENT**

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(73) Assignee: **Robert Bosch GmbH**, Stuttgart (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/763,070**

(22) PCT Filed: **Jun. 30, 1999**

(86) PCT No.: **PCT/DE99/01880**

§ 371 (c)(1),
(2), (4) Date: **Feb. 16, 2001**

(87) PCT Pub. No.: **WO01/02224**

PCT Pub. Date: **Jan. 11, 2001**

(51) **Int. Cl.**[7] **A47L 1/02**; B60S 1/02
(52) **U.S. Cl.** **15/250.454**; 15/250.43
(58) **Field of Search** 15/250.43, 250.44, 15/250.451, 250.452, 250.453, 250.454

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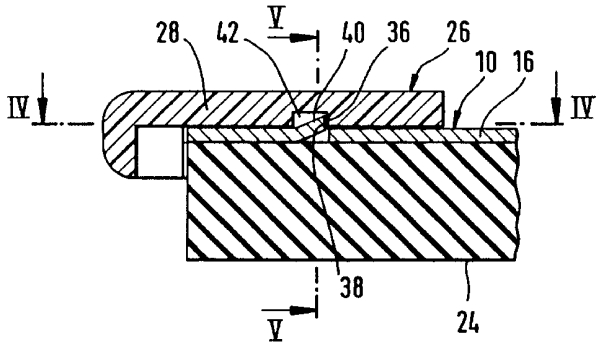
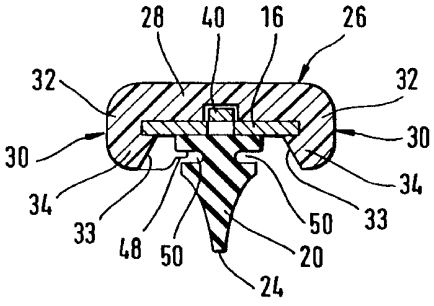
Primary Examiner—Terrence R. Till
(74) *Attorney, Agent, or Firm*—Michael J. Striker

(57) **ABSTRACT**

In a wiper blade (**10**) a termination part (**26** or **126** or **232** or **326**) which covers each end of the wiper blade (**10**) has a base body (**28**), located on the side remote from the window (**18**) and bracing itself on the wiper blade (**16**, **20**) which base body is provided with hook-like extensions (**30** or **330**) that cross the support element (**126**) on both of its long sides and engage the side of the support element toward the window from behind; if at least one detent shoulder (**36** or **132**) pointing toward the other end portion is disposed oh each of the two end portions of the support element, and a counterpart shoulder (**38** or **134**) present on the termination part is associated with the detent shoulders; and if furthermore at least one of the two shoulders and/or at least one of the two extensions is elastically deflectable.

13 Claims, 4 Drawing Sheets





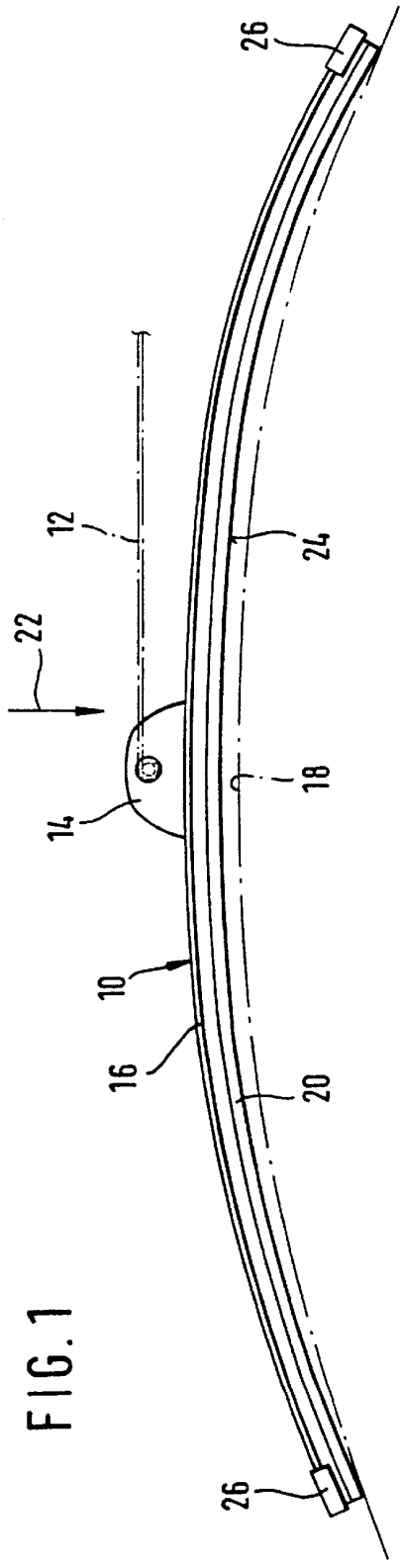


FIG. 1

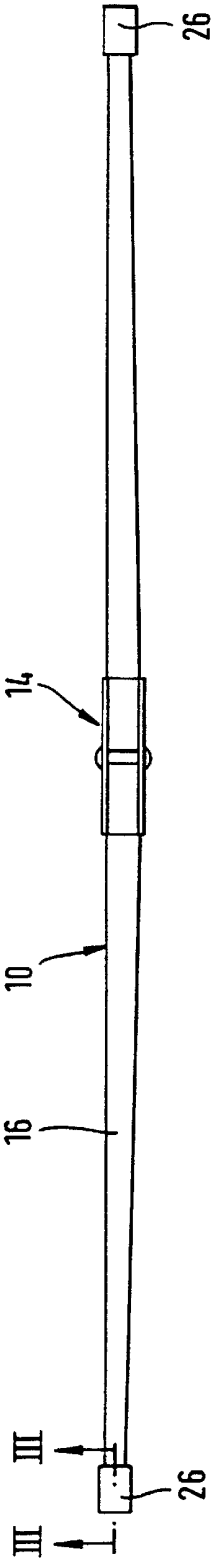


FIG. 2

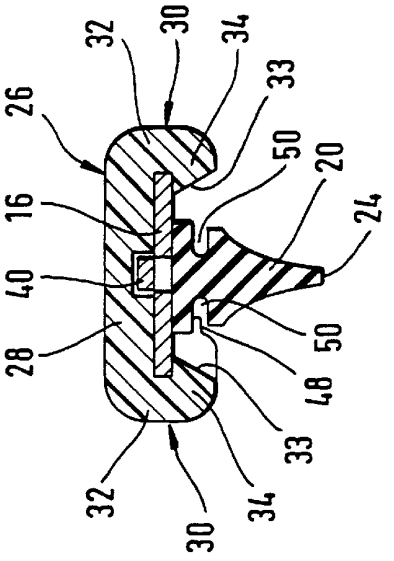


FIG. 5

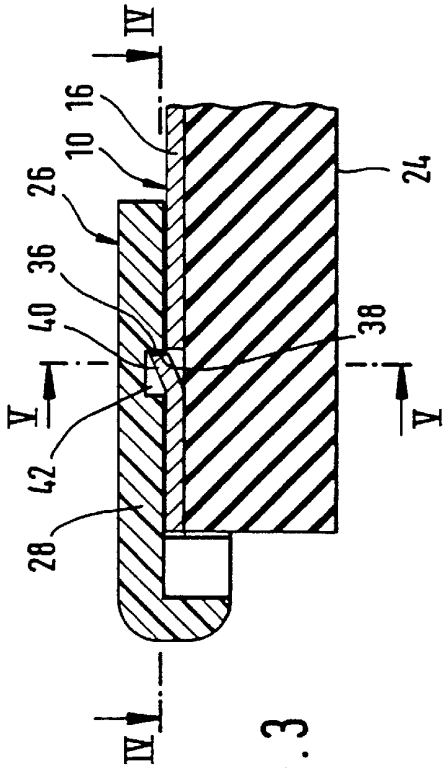


FIG. 3

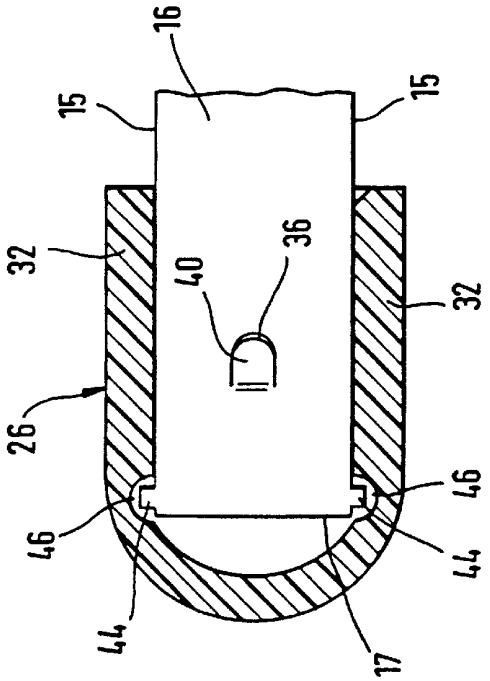


FIG. 4

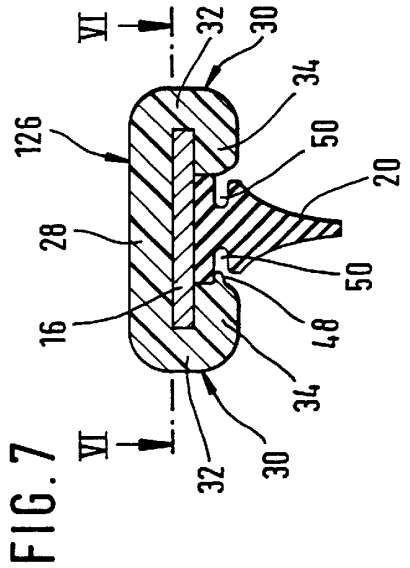


FIG. 7

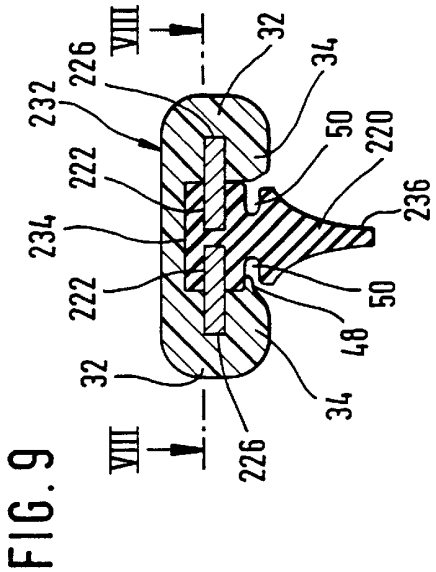


FIG. 9

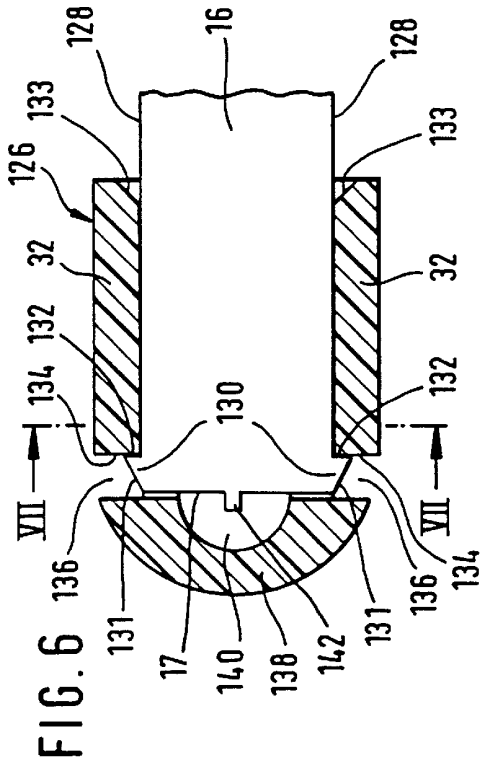


FIG. 6

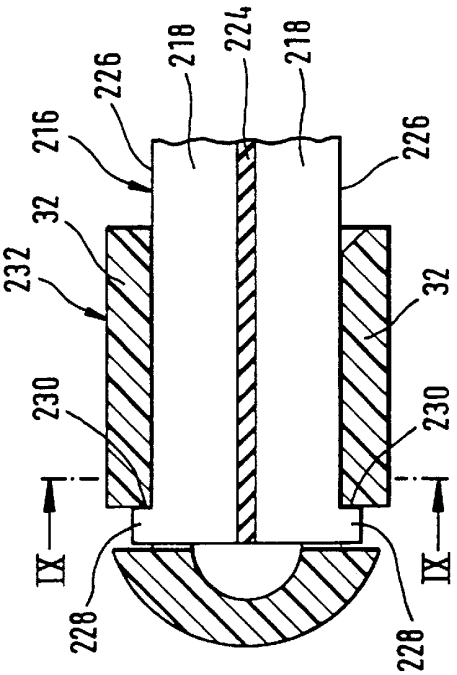


FIG. 8

FIG. 10

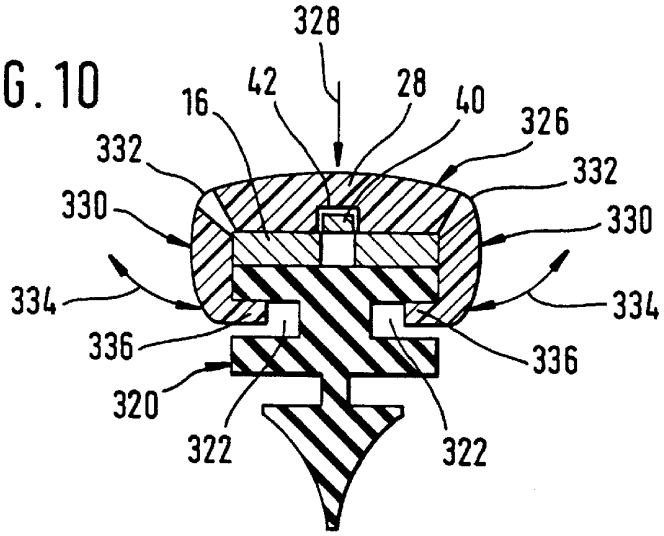


FIG. 11

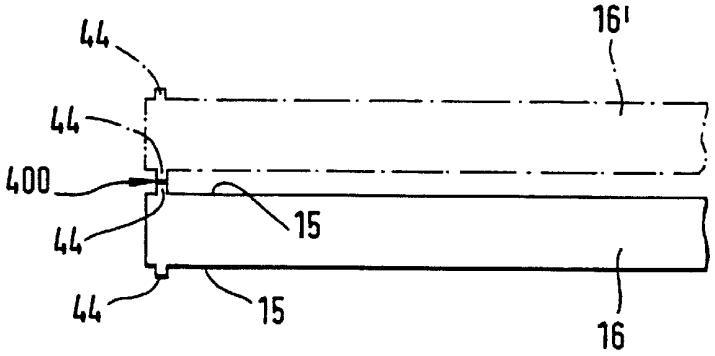
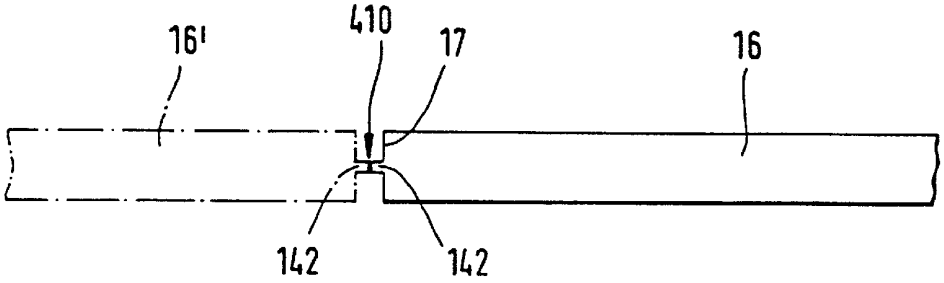


FIG. 12



WIPER BLADE FOR THE GLASS SURFACES OF MOTOR VEHICLES WITH AN ELONGATED, SPRING-ELASTIC SUPPORT ELEMENT

BACKGROUND OF THE INVENTION

In wiper blades, the support element is meant, over the entire wiping field swept by the wiper blade, to assure that most uniform possible distribution of the wiper blade contact pressure against the window or glass, which pressure originates in the wiper arm. By element—that is, when the wiper blade is not resting against the window—the ends of the wiper strip, placed entirely against the window during operation of the wiper blade, are urged toward the window by the then-tensed support element, even if the radii of curvature of spherically curved vehicle windows change at each wiper blade position. The curvature of the wiper blade must accordingly be somewhat greater than the maximum curvature measured in the wiping field of the window to be wiped. The support element thus replaces the complicated support bracket construction with two spring rails disposed in the wiper strip of the kind used in conventional wiper blades (German Published, nonexamined Patent Application DE-OS 15 05 357).

The invention is based on a wiper blade as generically defined by the preamble to claim **1**. In a known wiper blade of this type (U.S. Pat. No. 3,785,002), a shield-like termination part is disposed on each of its two end portions; with a comparatively long tongue, it rests on the top side, remote from the window, of the support element that is constructed of two leaf springs one above the other, and for securing the mounting position in the longitudinal direction, it has a cam that engages a recess of the upper leaf spring. Crosswise to the length of the wiper blade, the position securing is effected by means of a tunnel-like embodiment of the wiper strip on its two end regions that surround the support element together with the tongues of the two termination parts. The thus-fixed termination parts completely cover the ends of the wiper strip in the region of the sharp-edged support element. The design of the known wiper blade requires cost-intensive production processes both for the wiper strip and for the support element and the termination parts. Mounting the known wiper blade furthermore requires a plurality of mounting steps that can be done only by hand. Finally, the tongues of the termination parts stiffen the ends of the support element, which—especially in the case of spherically curved windows—has an unfavorable effect on the desired uniform distribution of contact pressure of the wiper strip against the window.

SUMMARY OF THE INVENTION

In the wiper blade according to the invention, the termination part can be embodied as short enough that no impairment of the elasticity of the support element occurs. The wiper strip can have a constant cross section over its entire length, and thus it can be produced economically by extrusion. Mounting the two termination parts is also done in a simple way by snapping them onto the support element or onto the already preassembled wiper blade, with the wiper strip retained on the support element. This snapping action can also be done by means of an automatic mounting station. The termination parts thus snapped on prevent injuries to persons handling the wiper blade from the ends of the support element, which as a rule have sharp edges.

If the support element is embodied as a one-piece spring band, on one band face of which, toward the window, the wiper strip is secured, and from the other band face of which, remote from the window, the detent shoulder protrudes, the support element can be produced economically and without waste from spring band steel.

In a detent shoulder embodied in this way, it is expedient if on the side of the termination part base body toward the support element, a throat is disposed, on which the counterpart shoulder of the termination part is embodied.

In certain advantageous production methods for the support element, it can happen that some protrusions remain on the long sides of the end regions of the support element, and these protrusions make it more difficult for the termination parts to snap cleanly onto the support element. These restrictions are avoided if cavities for receiving protrusions protruding from the long sides of the support element are disposed in the hook legs, crossing the support element, of the hook-like extensions of the termination part.

In certain versions of the wiper blade, it can be advantageous if the support element is embodied as a one-piece spring band, on one band face of which, toward the window, the wiper strip is secured, and the detent shoulder is embodied on at least one of the two long sides of the support element. It is possible in this respect to provide the detent shoulder on a peripherally open, partial recess disposed laterally on the support element.

An inexpensive embodiment of the counterpart shoulder is attained if the counterpart shoulder is embodied on the hook legs of the hook-like extensions of the termination part that cross the support element.

Especially whenever the width of the support element narrows toward its two ends, it is advantageous if the detent shoulder is embodied on a detent tooth that protrudes from the long side of the support element.

In another production process for the support element, which is expedient in certain cases, it can happen that some small protrusions remain on the face ends of the support element that prevent the termination parts from being snapped onto the support element. If such a method is employed, it has proved advantageous if a recess for receiving a protrusion protruding from the face end of the support element is disposed on the inside wall, covering the face end of the support element, of the termination part.

A further embodiment of the wiper blade of the invention is distinguished in that the hook-like extensions that cross the support element and engage the side of the support element toward the window from behind are each joined by a respective film hinge to the base body of the termination part. The result is an especially simple mounting of the termination parts on the support element, because they merely have to be placed in their operating position on the support element, or on the support element already equipped with the wiper strip; after that, the hook-like extensions need merely be hinged into their securing positions.

Additional security of the connection between the support element and the wiper strip is obtained if the wiper strip, on both of its long sides, has a respective longitudinal groove, the inside of which is engaged by the claw legs, oriented toward one another and disposed on the hook legs, of the termination part.

In a further embodiment of the wiper blade, which is expedient for certain applications, the support element has two elongated, spring-elastic retaining rails, which are each disposed one of the two longitudinal grooves extending along both long sides of the wiper strip, and the retaining rails protrude with their long edges remote from one another out of their longitudinal grooves of the wiper strip, and the detent shoulder is embodied on at least one of these two long edges.

In a wiper blade constructed in this way, the counterpart shoulder of the termination part that is associated with the detent shoulder of the retaining rails are disposed on the hook-like extensions that cross the support element having the two retaining rails. Besides the simple mounting of the termination parts, the result, at no additional effort or expense, is that the two retaining rails are reliably secured in their mounting positions of the wiper strip.

The desired simplicity of fastening the termination parts to the support element or wiper blade can be achieved especially well, along with economical production, if the termination part is made from an elastic plastic.

Further advantageous refinements and features of the invention are disclosed in the ensuing description of exemplary embodiments shown in the associated drawing.

BRIEF DESCRIPTION OF THE DRAWING

Shown in the drawing are:

FIG. **1**, the wiper blade of the invention in side view;

FIG. **2**, a plan view on the wiper blade of FIG. **1**;

FIG. **3**, a longitudinal section through one end of the wiper blade, taken along the line III—III of FIG. **2**, shown enlarged;

FIG. **4**, a section through the arrangement of FIG. **3** taken along the line IV—IV;

FIG. **5**, a cross section through the arrangement of FIG. **3** taken along the line V—V;

FIG. **6**, a section as in FIG. **4** taken along the line VI—VI in FIG. **7**, rotated by 90°, through a different embodiment of the invention;

FIG. **7**, a section through the arrangement of FIG. **6** taken along the line VII—VII;

FIG. **8**, a section as in FIG. **4** taken along the line VIII—VIII in FIG. **9**, rotated by 90°, through a different embodiment of the invention;

FIG. **9**, a section through the arrangement of FIG. **8** taken along the line IX—IX;

FIG. **10**, a section in accordance with FIG. **5** through a further embodiment of the invention;

FIG. **11**, a fragmentary sketch, reduced in size, of a support element belonging to the wiper blade, in order to explain one possible production method for the support element; and

FIG. **12**, a fragmentary sketch as in FIG. **11**, for a different production method for the support element.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A wiper blade **10** shown in FIGS. **1** and **2** belongs to a wiping apparatus for motor vehicle windows or other glass. The wiper blade **10** is secured to a driven wiper arm **12**, represented by dot-dashed lines, that belongs to the wiper system. To that end, it has a connection device **14**, with which it is pivotably connected to the free end of the wiper arm **12**. The wiper blade **10** has an elongated, spring-elastic support element **16**, on one band face of which, toward a window **18** of the motor vehicle, an elongated, rubber-elastic wiper strip **20** is held longitudinally parallel, for instance being glued on. The connection device **14** for the wiper arm **12** is seated on the other band face, remote from the windshield **18**, of the support element **16**. The wiper arm **12** and thus the wiper blade **10** as well are urged in the direction of the arrow **22** toward the motor vehicle windshield **18**, represented by dot-dashed lines in FIG. **1**, against which the wiper strip **20** that belongs to the wiper blade **10** can be pressed. In this operating position, the wiper blade is displaced by the wiper arm **12** crosswise to its length over the window **18** in order to clean the surface of the window. In FIG. **1**, however, the wiper blade **10** is shown in a position in which only its two ends touch the window **18**. To that end—as can be seen from FIG. **1**—the unstressed wiper blade is curved more sharply than the window **18**. Since the greatest curvature of the window surface is shown in FIG. **1**, it is quite clear that the curvature of the wiper blade **10**, resting with both ends on the window **18**, is greater than the maximum window curvature. Under the contact pressure (arrow **22**), the wiper blade presses with its wiper lip **24**, over the full length thereof, against the window. In the process, a tension builds up in the spring-elastic support element **16** that assures for a proper contact of the wiper strip or wiper lip, over its entire length, with the window **18**.

The special design of the wiper blade **10** will now be described in further detail. As FIGS. **1** and **2** show, one termination part **26** is disposed on each of the ends of the wiper blade **10**, and these termination parts cover the face end edges **17** of the support element **16**. Especially with support elements **16** made from a spring band steel, the termination parts **26** are intended to prevent the risk of injury from the sharp-edged face ends **17** of the support element **16** in the event that the final user of the wiper blade **10** handles it improperly, for instance when replacing wiper blades.

As FIGS. **3–5** for a first embodiment of the termination part **26** show, the termination part has a substantially plate-like base body **28**, which is braced against the support element **16**, on its side remote from the window, or on the wiper blade **10**. FIG. **5** shows that hook-like extensions **30** are disposed on the base body **28**; with legs **32**, they cross the two long sides of the support element **16** and engage the support element from behind with claws **34** that adjoin the legs and point toward one another. Since in this exemplary embodiment the support element **16** is wider than the wiper strip **20**, the extensions **30** surround only the side regions of the support element **16**. To secure the termination parts **26** to the support element **16** in the longitudinal direction of the support element, a detent shoulder **36** pointing toward the other end portion is disposed on both portions of the support element; this detent shoulder is assigned a counterpart shoulder **38** provided in the base body **28** of the termination part **26**. The detent shoulder **36** of the support element **16**, embodied as a one-piece spring band, is embodied on the edge, pointing toward the other support element end, of a spring tab **40** cut free on three sides sheared out of the spring band and pressed through to the band face of the support element remote from the wiper strip **20**; this spring tab is not shown in section in FIG. **4**. In the mounting position of the termination part **16** (FIG. **3**), this spring tab protrudes into a throat **42**, oriented toward it, of the base body **28**, and the wall of the throat **42** toward the detent shoulder **36** forms the counterpart shoulder **38** that cooperates with the detent shoulder **36**. The mounting of the termination part **26** onto the support element **16** can be achieved by slipping the termination part onto the support element **16** in the longitudinal direction of the support element. Since the termination part is made from an elastic plastic, it can temporarily deflect elastically during assembly, until it reaches its final position. It is also possible for the spring tab **40** to be made elastically resilient, so that temporarily it can deflect until it snaps into the throat **42**. In certain production methods for the support element **16**, it can happen that there are no protrusions **44**, whose origin will be explained hereinafter, remaining on the lateral end regions **15** of the support

element **16**. If proper mounting of the termination parts **26** is to be possible, cavities **46** for receiving the protrusions **44** are disposed in the legs **32** of the termination part **26** that cross the support element **16**. In this case, the mounting is done from above, and the hook-like extensions **30** are deflected toward the side. To that end, the claws **34** have deflection chamfers **33**, which in the clipping-on process cause a deflection of the extensions **30**.

In a second embodiment of the invention, shown in FIGS. **6** and **7**, the termination part **126** corresponds substantially to the termination part **26** described above. FIG. **7** shows that the termination part **126** likewise has a platelike base body **26**, on which hook-like extensions **30** are disposed, whose hook legs **32** cross the plane of the support element **16** and, with claws **34**, engage the side of the support element or wiper blade toward the window **18** from behind. For securing the mounting position in the longitudinal direction of the wiper blade, the requisite detent shoulder is embodied on the end portions of the two long sides **128** of the support element, on the support element **16** that once again is embodied as a one-piece spring band. This detent shoulder is located on teeth **130**, protruding laterally from the long sides **128** of the support element, whose edges pointing toward the other end of the support element **16** form the detent shoulders **132**. The counterpart shoulders **134** cooperating with the detent shoulders **132** are formed by the walls, toward the detent shoulders **132**, of transverse channels **136**, which free up the hook-like extensions **30** relative to the face end **138** of the termination part **126** to allow these extensions to be deflected more easily. As FIG. **6** also shows, a recess **140** is provided in the face end **138**, for receiving a protrusion **142** at the face end edge **17** of the support element **16**, which protrusion remains from a particular production method for the support element **16**, and whose creation will be discussed hereinafter in further detail. It is naturally conceivable in the embodiment of the invention of FIGS. **3–6** as well to provide the crosswise channel **136** instead of the cavities **46**. FIG. **6** shows that the two teeth **130** of the support element **16** are provided with approach chamfers **131** that extend at an incline toward the end edge **17** and that in cooperation with oblique connection halves **133** on the legs **32** of the extensions **30** assure easy mounting of the termination parts **126**, since when the termination parts are slipped onto the support element **16** in its longitudinal direction, the extensions deflect elastically automatically, until the teeth **130** enter the crosswise channels **136**.

In a further embodiment of the invention, shown in FIGS. **8** and **9**, the support element **216** is formed by two elongated, spring-elastic retaining rails **218**. Once the wiper blade has been mounted, these two retaining rails are each located in one of two longitudinal grooves **222** present on the two long sides of the wiper strip **220**. A strut **224** that forms the bottom of the respective groove remains between the two longitudinal grooves **222** in the wiper strip.

The two retaining rails **218** protrude with their two long edges **226**, remote from one another, from their longitudinal grooves **222** of the wiper strip **220**. Attachments **228** protruding from the long edges **226** are disposed on each end of the two retaining rails **218**, and the shoulders **230** of these extensions, pointing toward the other end of the support element **216**, cooperate with counterpart shoulders assigned to them of the termination part **232** when the corresponding termination part is located in the mounting position shown in FIG. **8**. Since the termination part used in this embodiment corresponds substantially to the termination part **126** of the embodiment described above, it can be explained by referring to the description of the termination part **126**. In a departure from the termination part **126** of FIGS. **6** and **7**, the termination part **232** of FIGS. **8** and **9** is provided with a groovelike longitudinal recess **234**, for receiving part of the wiper strip **220**, only in the region of its base body **28**; because of how the retaining rails **218** are disposed in the longitudinal grooves **222** of the wiper strip, this longitudinal recess remains on the side remote from the wiper lip **236** of the wiper strip **220**. The mounting of the termination part **232** can be done in the way explained for instance in conjunction with FIGS. **6** and **7** for the proceeding exemplary embodiment. Mounting can be made still easier because the strut **224** that remains between the longitudinal grooves **222** can be deformed elastically, transversely to its length, in the course of mounting the termination parts **232**. The counterpart shoulders of the termination part **232**, which cooperate with the detent shoulders **230** of the extensions **228**, are equivalent to the counterpart shoulders **134** of the previous embodiment.

A further embodiment of the invention, shown in FIG. **10**, allows mounting of the termination part **326** in the direction of the arrow **328**. In this embodiment, the support element is entirely equivalent to the support element **16** of FIGS. **3–5**. In other words, it too has spring tabs **40** on its ends, and these tabs are cut out of it and pressed out of the wall face remote from the wiper strip **320**. The detent shoulders **36** are embodied on these spring tabs **40** and cooperate with corresponding counterpart shoulders **38** that are disposed at the throat **42** in the base body **28** of the termination part **326**. In the embodiment of FIG. **10**, the wiper strip **320** is essentially as wide as the support element **16**. On both of its opposed long sides, it has longitudinal grooves **322**. In a departure from the embodiment of FIGS. **3–5**, the hook-like extensions **330** are joined to the base body **28** of the termination part **326** by film hinges **332**. The hook-like extensions **330** are also likewise freed up relative to the face end wall **138** (FIGS. **6** and **7**) of the termination part, for instance by means of suitable crosswise channels **136**, so that they are pivotable in the direction of the two double arrows **334**. For mounting, the termination part **326** is placed in the direction of the arrow **328** onto the band face of the support element **16** remote from the window, so that the spring tab **40** of the support element **16** enters the cavity **46** of the termination part **326**, whereupon the detent shoulder **36** and the counterpart shoulder **38** prevent longitudinal shifting of the termination part **326**. The fastening of the termination part **326** to the wiper blade is attained and assured by means of a suitable pivoting **334** of the hook-like extensions **330**, whose claws **336**, becoming slightly deformed, dip into the wall facing them and are firmly held there. Although in this embodiment the hook-like extensions dip into the longitudinal grooves of the wiper strip **320**, they still engage the side of the support element toward the window from behind.

It is accordingly a common feature of all the exemplary embodiments that the termination part **26** or **126** or **232** or **326** has a base body **28**, braced on the wiper blade and located on the side of the support element remote from the window **18**, and this base body is provided with hook-like extensions **30** or **330**, crossing the support element on both of its long sides and engaging the side of the support element toward the window from behind; on each of the two end portions of the support element, there is at least one detent shoulder **36** or **132** or **230**, pointing toward the other end portion, which is assigned a counterpart shoulder **38** or **134** on the termination part; and at least one of the two shoulders is elastically deflectable. The elasticity of the plastic to be

used to produce the termination parts **26** or **126** or **232** or **326** should be selected such that on the one hand problem-free mounting is possible, but on the other a reliable seat of the termination parts in their mounting position is assured.

In the embodiments described in conjunction with FIGS. **3–5**, **6** and **7** and **8** and **9**, it can be advantageous if at least one of the claws **34**, with a retaining tab **48**, engages a longitudinal recess **50** present on the wiper strip **20** or **220**, in order to secure the connection, which is subject to especially heavy stress, between the support element and the wiper strip on the ends of the wiper blade.

In one possible production method for the support element **16** (FIG. **11**), this support element is cut out of a wide spring band strip, using a cutting tool. To simplify further machining of the support element **16**, however, the support elements **16**, **16'** cut out one after the other (shown in dot-dashed lines) and subsequent ones are left hanging on one another by connecting struts **400**, so that the support elements **16**, **16'** for instance are guided in good order through a bath for treating the support element surfaces and can then be delivered to further handling stations. Shortly before the mounting of the wiper blade, the individual support elements **16**, **16'** are then separated from one another by breaking the narrow connecting struts **400**, as a result of which the protrusions **44** described in conjunction with FIG. **4** remain on each of the support elements.

In another possible production method for the support element **16**, **16'** (shown in dot-dashed lines in FIG. **12**), a narrow spring steel strip is guided in the longitudinal direction through a cutting tool, which cuts the support elements **16**, **16'** to length as needed, while letting them cohere via a narrow connecting strut **410** for the reason mentioned above. In this case as well, simple further treatment of the support elements **16**, **16'** thus becomes possible; before the mounting of the wiper blade, they are then separated from one another in that the connecting struts **410** are broken. The small protrusions **142** described in conjunction with FIG. **6** then remain on each support element but do not impair the function of the support element.

What is claimed is:

1. A wiper blade **(10)** for windows or other glass of motor vehicles, having an elongated, spring-elastic support element **(16)**, on whose side toward the window or glass an elongated, rubber-elastic wiper strip **(20)** that can be placed against the window or glass is located parallel to the longitudinal axis, and on the side of the support element remote from the window or glass, in the middle portion of the support element, a device for attaching a driven wiper arm is disposed, the two ends of the wiper blade **(10)** each being covered by a respective termination part **(26)** in the region of the support element **(16)**, characterized in that the termination part **(26)** has a base body **(28)**, located on the side of the support element **(16)** remote from the window **(18)** and bracing itself on the wiper blade **(16, 20)**, which base body is provided with hook-like extensions **(30** or **330)** that cross the support element **(16)** on both of its long sides and engage the side of the support element **(16)** toward the window from behind; that at least one detent shoulder **(36** or **132)** pointing toward the other end portion is disposed on each of the two end portions of the support element, and a counterpart shoulder **(38** or **134)** present on the termination part **(26** or **126)** is associated with the detent shoulder; and that at least one of the two shoulders **(36, 132, 38, 134)** and/or at least one of the two extensions **(30)** is elastically deflectable.

2. The wiper blade of claim **1**, characterized in that the support element **(16)** is embodied as a one-piece spring band, on one band face of which, toward the window, the wiper strip **(20)** is secured, and from the other band face of which, remote from the window, the detent shoulder **(36)** protrudes.

3. The wiper blade of claim **2**, characterized in that on the side of the termination part base body **(28)** toward the support element **(16)**, a throat **(42)** is disposed, on which the counterpart shoulder **(38)** of the termination part **(26)** is embodied.

4. The wiper blade of claim **1**, characterized in that cavities **(46)** for receiving protrusions **(44)** protruding from the long sides of the support element are disposed in the hook legs **(32)**, crossing the support element **(16)**, of the hook-like extensions **(30)** of the termination part **(26)**.

5. The wiper blade of claim **1**, characterized in that the support element **(16)** is embodied as a one-piece spring band, on one band face of which, toward the window **(18)**, the wiper strip **(20)** is secured, and that the detent shoulder **(132)** is embodied on at least one of the two long sides of the support element.

6. The wiper blade of claim **5**, characterized in that the counterpart shoulder **(134)** is embodied on the legs **(32)** of the hook-like extensions of the termination part **(26)** that cross the support element **(16)**.

7. The wiper blade of claim **5**, characterized in that the detent shoulder **(132)** is embodied on a detent tooth **(130)** that protrudes from the long side of the support element.

8. The wiper blade of claim **5**, characterized in that a recess **(140)** for receiving a protrusion **(142)** protruding from the face end of the support element is disposed on the inside wall, covering the face end **(17)** of the support element **(16)**, of the termination part **(26)**.

9. The wiper blade of claim **1**, characterized in that the hook-like extensions **(330)** that cross the support element and engage the side of the support element **(16)** toward the window from behind are each joined by a respective film hinge **(332)** to the base body **(28)** of the termination part **(326)**.

10. The wiper blade of claim **9**, characterized in that the wiper strip **(320)**, on both of its long sides, has a respective longitudinal groove **(322)**, the inside of which is engaged by the claw legs, oriented toward one another and disposed on the hook legs, of the termination part.

11. The wiper blade of claim **1**, characterized in that the support element **(216)** has two elongated, spring-elastic retaining rails **(218)**, which are each disposed in one longitudinal groove **(222)** extending along both long sides of the wiper strip; that the retaining rails **(218)** protrude with their long edges remote from one another out of their longitudinal grooves **(222)** of the wiper strip **(220)**; and that the detent shoulder **(230)** is embodied on at least one of these two long edges.

12. The wiper blade of claim **11**, characterized in that the counterpart shoulder of the termination part that are associated with the detent shoulder **(230)** of the retaining rails **(218)** are disposed on the hook-like extensions **(32, 34)** that cross the support element **(216)** having the two retaining rails.

13. The wiper blade of claim **1**, characterized in that the termination part **(26** or **126** or **232** or **326)** is made from an elastic plastic.

* * * * *

EXHIBIT E

US006836926B1

(12) **United States Patent**
De Block

(10) **Patent No.: US 6,836,926 B1**
(45) **Date of Patent: Jan. 4, 2005**

(54) **WIPER BLADE FOR WINDSHIELDS, ESPECIALLY AUTOMOBILE WINDSHIELDS, AND METHOD FOR THE PRODUCTION THEREOF**

(75) Inventor: **Peter De Block**, Halen (BE)

(73) Assignee: **Robert Bosch GmbH**, Stuttgart (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 312 days.

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(22) PCT Filed: **Jul. 6, 2000**

(86) PCT No.: **PCT/DE00/02168**

§ 371 (c)(1),
(2), (4) Date: **May 3, 2001**

(87) PCT Pub. No.: **WO01/03982**

PCT Pub. Date: **Jan. 18, 2001**

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Jul. 9, 1999 (DE) 199 31 857
Jul. 9, 1999 (DE) 199 31 858
Jul. 5, 2000 (DE) 100 32 048

(51) **Int. Cl.**[7] **A47L 1/00**; B60S 1/02
(52) **U.S. Cl.** **15/250.43**; 15/250.451
(58) **Field of Search** 15/250.43, 250.44, 15/250.451, 250.48, 250.361, 250.202, 250.33

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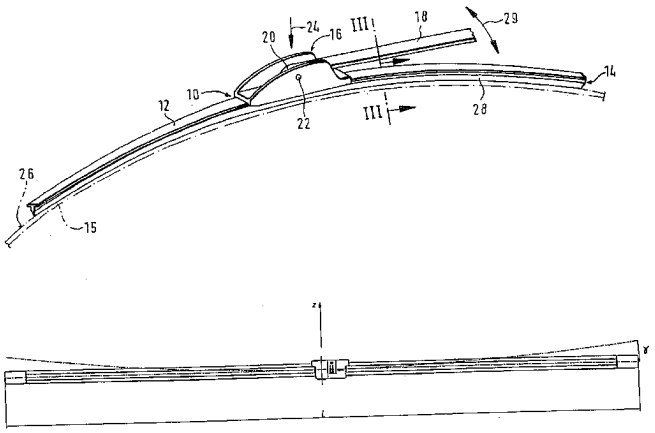
Primary Examiner—Robert J. Warden, Sr.
Assistant Examiner—Laura C Cole
(74) *Attorney, Agent, or Firm*—Michael J. Striker

(57) **ABSTRACT**

The invention relates to a wiper blade for windshields, especially automobile windshields, comprising at least one support element, a support element **(12)**, a wiper strip **(14)** and connecting means **(16)** for a wiper arm **(18)**. The support element **(12)** is a long flat rod to which the wiper strip **(14)** and the connecting means **(16)** are fixed. According to the invention, the flat rod has a cross-sectional profile **(40)**, whereby $F_{wf}*L^2/48*E*I_{zz}<0.009$ when F_{wf} is the pressure force exerted on the wiper blade or the pressure force for which the wiper blade was originally intended, L represents the length of the wiper blade, E stands for the elasticity module of the flat rod material and I_{zz} is the moment of inertia of the cross-sectional profile around the z axis (perpendicular to an s axis associated with the flat rod and perpendicular to the y axis).

11 Claims, 6 Drawing Sheets



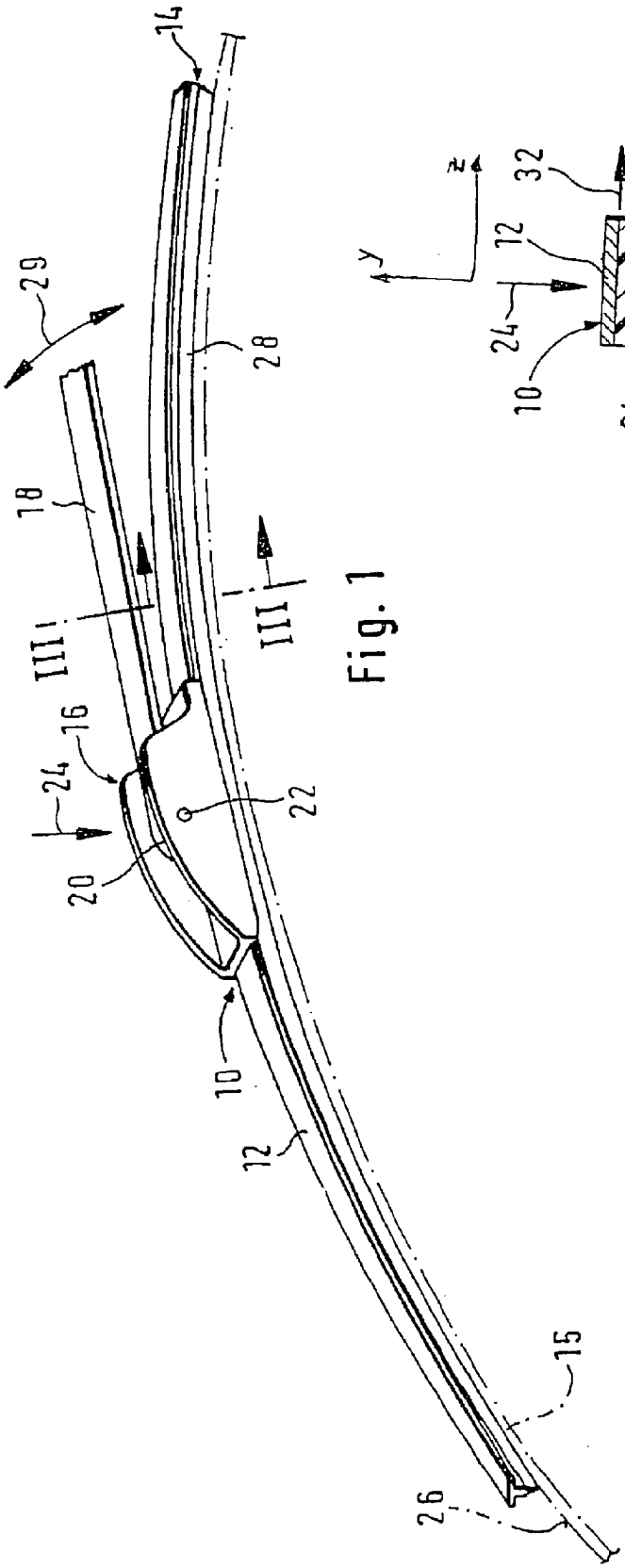

14
29
28
18
III
III
16
24
22
20
10
12
15
26

Fig. 1

z
y
32
14
26
15
30
12
24
10
34
28

Fig. 3

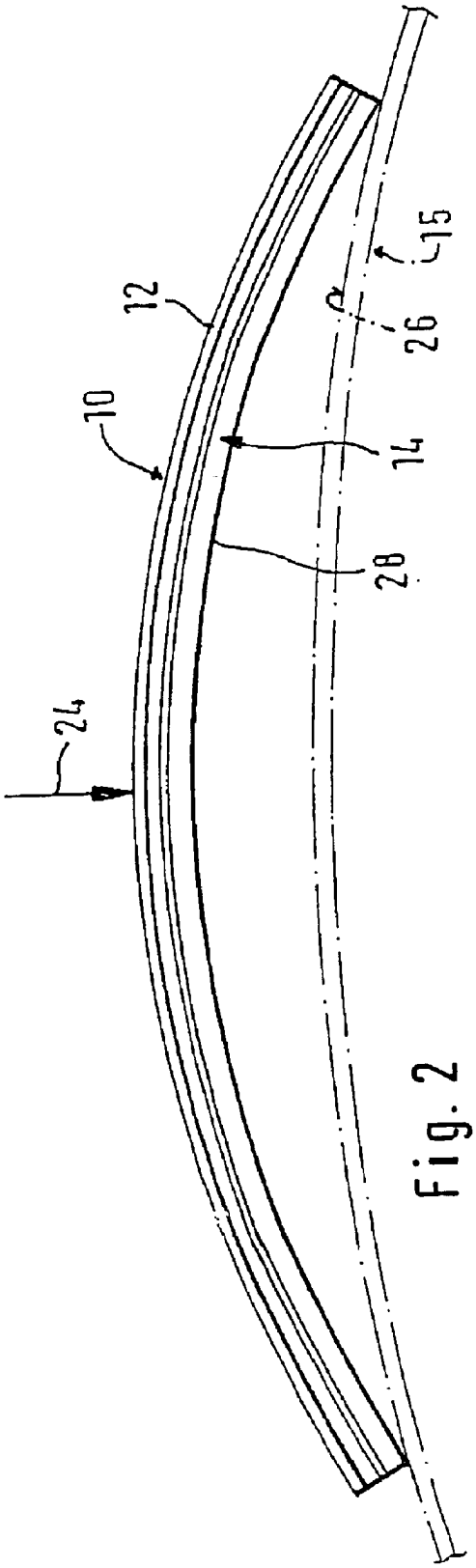


Fig. 2

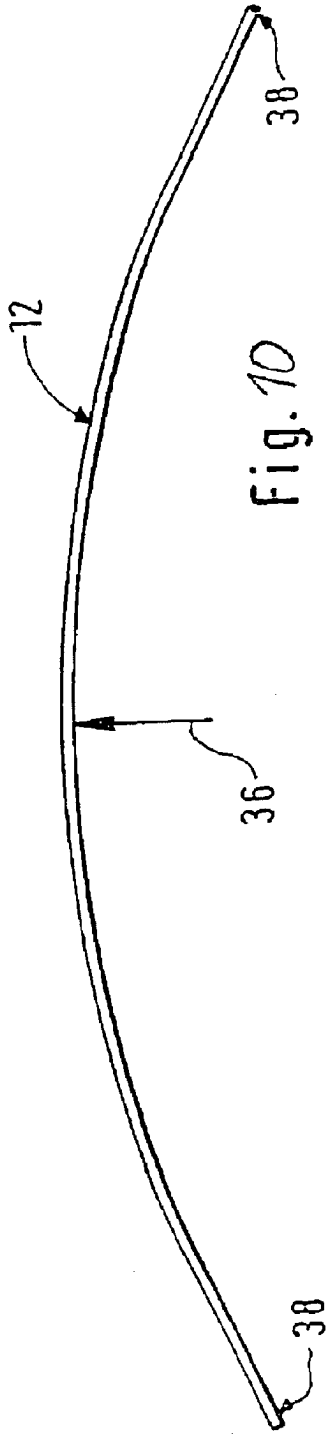


Fig. 10

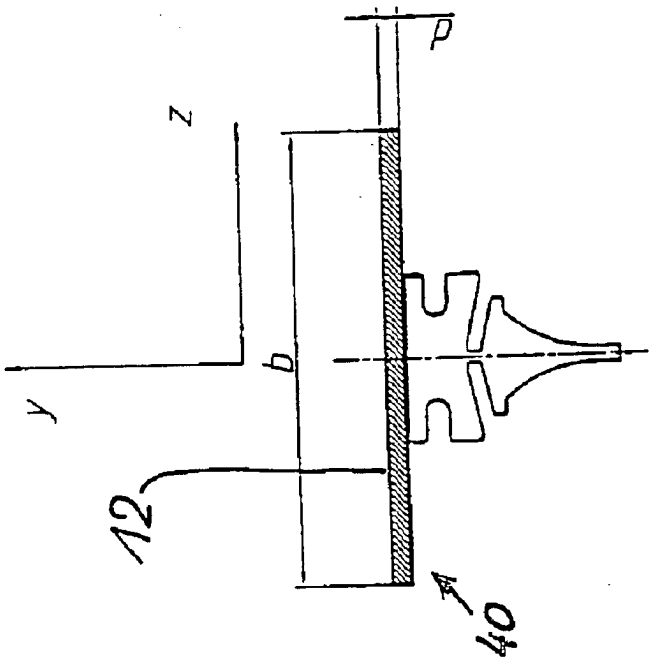


Fig. 4

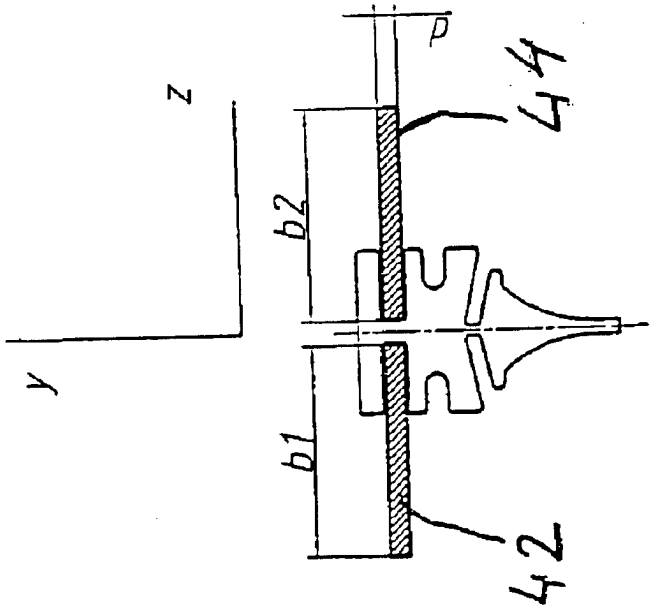


Fig. 5

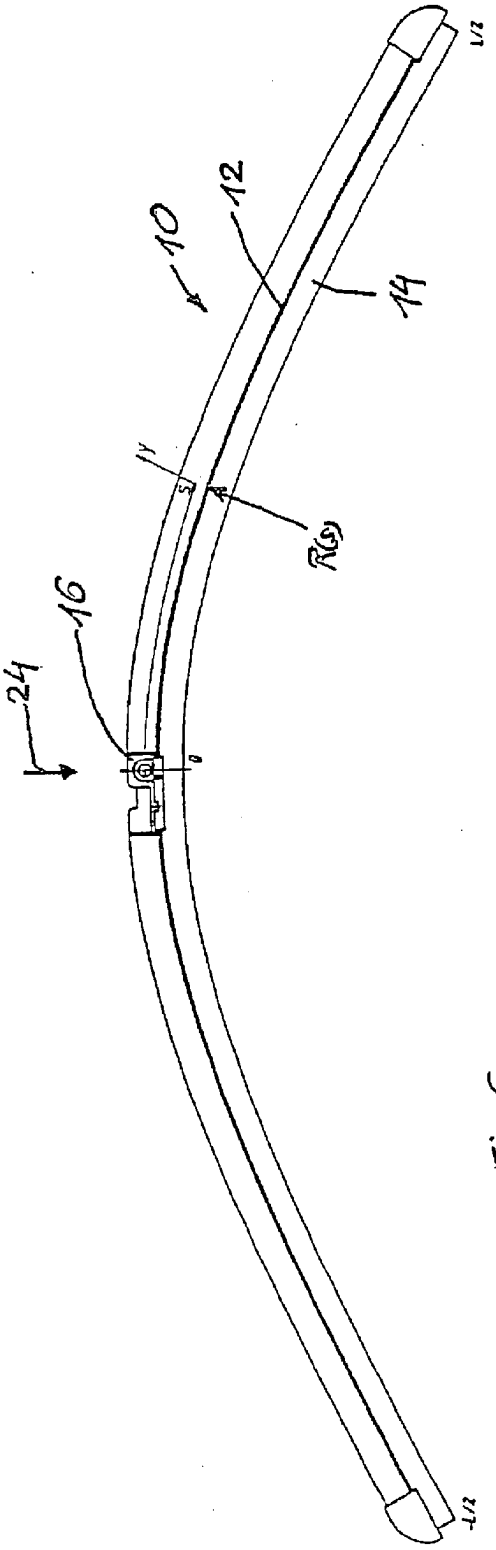


Fig. 6

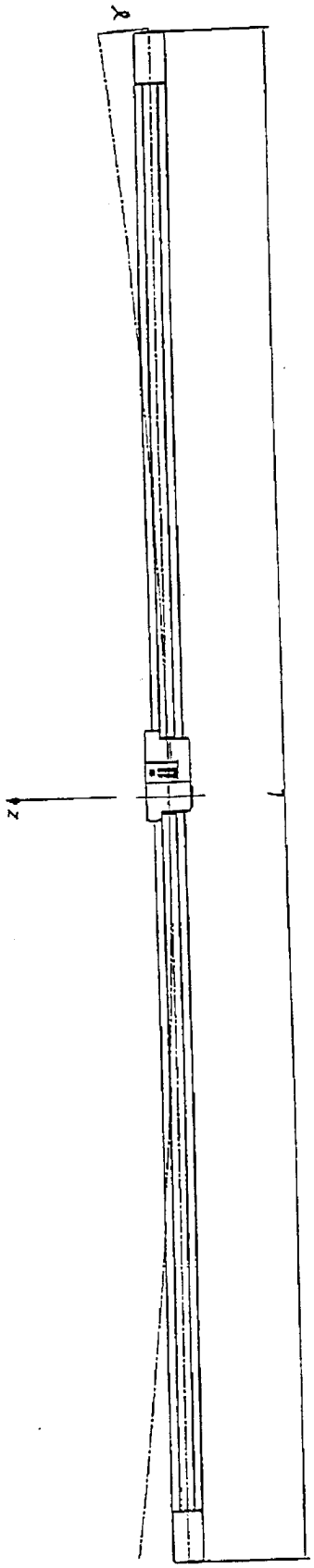


Fig. 7

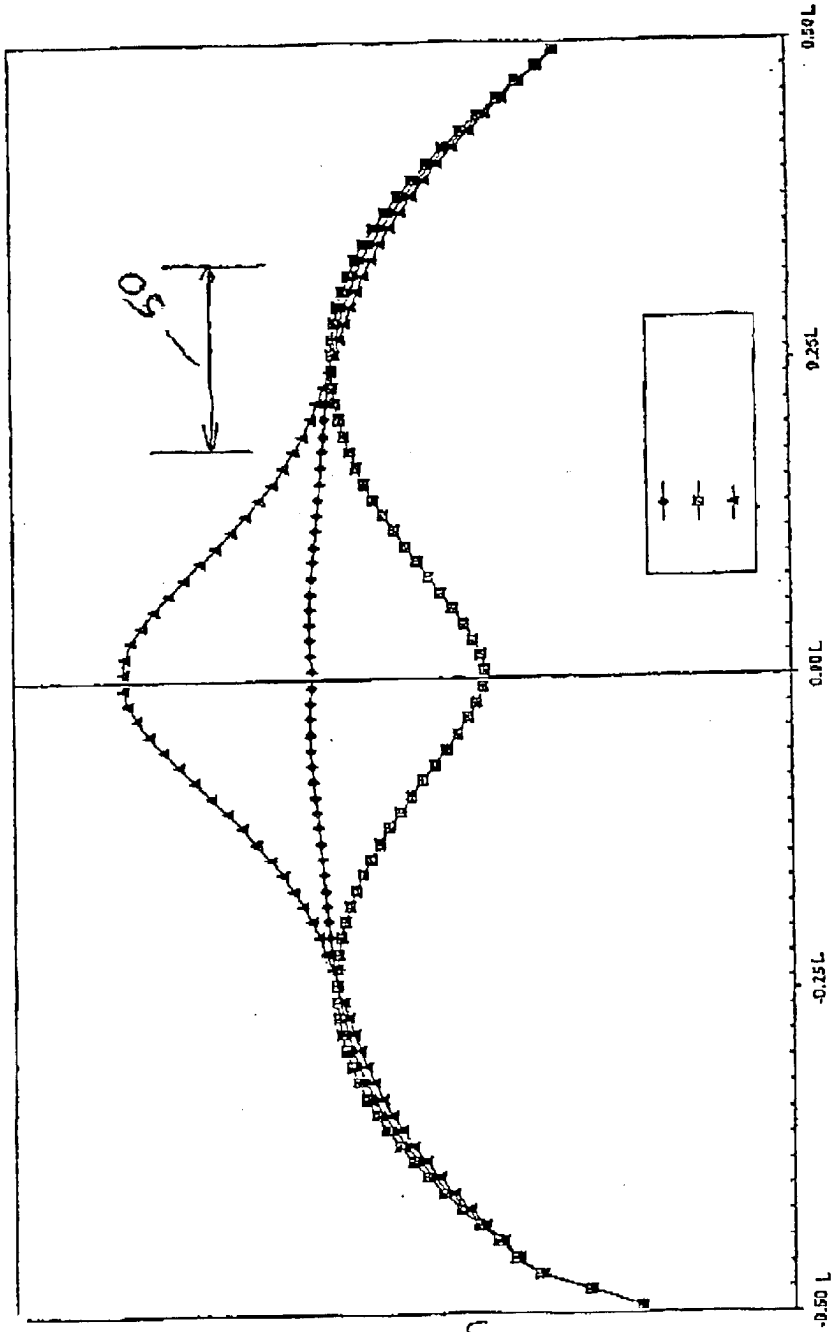

0.50L
0.25L
0.00L
-0.25L
-0.50 L
δ0
Bearing load distribution (N/m)
Extended Length s (mm)

Fig. 8

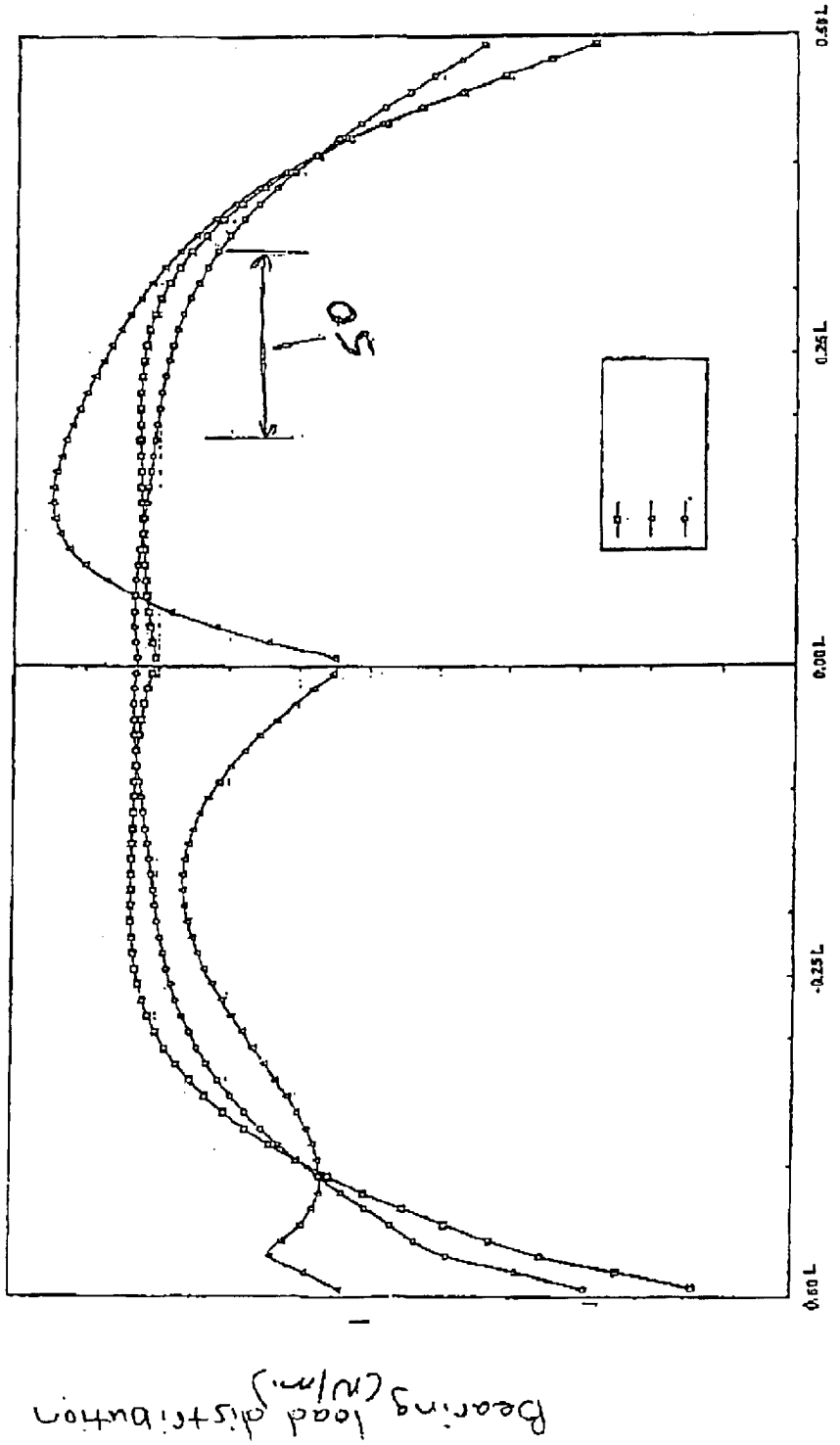

δ
0.50 L
0.25 L
0.00 L
-0.25 L
-0.50 L
gestreckte Lange, [mm]
Extended length (mm)
Bearing load distribution (N/m)

Fig. 9

WIPER BLADE FOR WINDSHIELDS, ESPECIALLY AUTOMOBILE WINDSHIELDS, AND METHOD FOR THE PRODUCTION THEREOF

BACKGROUND OF THE INVENTION

In wiper blades of the present invention, the support element should assure a predetermined distribution of the wiper blade pressing force—often also called pressure—applied by the wiper arm against the window, over the entire wiping zone that the wiper blade sweeps across. Through an appropriate curvature of the unstressed support element—i.e. when the wiper blade is not resting against the window—the ends of the wiper strip, which is placed completely against the window during the operation of the wiper blade, are loaded in the direction of the window by the support element, which is then under stress, even when the curvature radii of spherically curved vehicle windows change in every wiper blade position. The curvature of the wiper blade must therefore be slightly sharper than the sharpest curvature measured in the wiping zone of the window to be wiped. The support element thus replaces the costly support bracket design that has two spring strips disposed in the wiper strip, which is the kind used in conventional wiper blades (DE-OS 15 05 357).

The invention is based on a wiper blade as generically defined by the independent claims. In a known wiper blade of this type (DE-PS 12 47 161), a number of embodiments of the support elements are provided as a solution to the problem of producing the most uniform possible pressure load of the wiper blade over its entire length against a flat window.

In another known wiper blade of this generic type (EP 0 528 643 B1), in order to produce a uniform pressure load of the wiper blade against spherically curved windows, the pressure load increases significantly in the two end sections when the wiper blade is pressed against a flat window.

The uniform pressure distribution over the entire wiper blade length that is sought in both cases, however, leads to an abrupt flipping over of the wiper lip, which belongs to the wiper blade and performs the actual wiping function, over its entire length, from its one drag position into its other drag position when the wiper blade reverses its working direction. This drag position is essential for an effective, quiet operation of the wiper system. The abrupt flipping over of the wiper lip, however,—which is inevitably connected with an up and down motion of the wiper blade—generates an undesirable tapping noise. In addition, the matching of the support element tension to the desired pressure distribution, which differs from case to case, is problematic with spherically curved windows.

EP 0 594 451 describes flat bar wiper blades with a varying profile, which should not to exceed a particular lateral deflection when a test force is applied to them. To that end, an extremely complex interrelationship among internal parameters that characterize the spring bar are used to determine a quantity which should not exceed a certain threshold value. The equation given permits only complex and incomplete conclusions to be reached regarding the actual quantities to be entered. The other data relate to an unstressed wiper blade so that it is hardly possible to draw conclusions as to the quality of a wiper blade during operation.

In addition, putting the teaching of the known prior art to use turns out to be difficult since the available parameters cannot be applied directly to wiper blades to be newly manufactured.

SUMMARY OF THE INVENTION

The wiper blade according to the invention, with the features of the main claim, has the advantage of an entirely favorable wiping quality because among other things, a rattling of the wiper blade across the window—the so-called slip-stick effect—is prevented. This results from the knowledge that for the slip-stick effect, attention must be paid particularly to the lateral deflection angle and less so to the absolute lag, i.e. the absolute deflection of the tips under stress. It is therefore advantageous if the wiper blade is designed so that the lateral deflection of the ends of the wiper blades, which lag behind during operation, does not exceed a lateral deflection angle of a particular magnitude. From the quantity discovered for this angle, important parameters can then be derived for the wiper blade, which have a simple relation to one another and which, in this relation, should not exceed an upper limit of 0.009. With the aid of this relation and the upper limit indicated, cross sectional profiles for the support element can be very simply determined, which then produce a favorable wiping result. In particular, wiper blades with a constant cross section over their lengths are particularly easy to produce in this manner.

Advantageous improvements and embodiments of the wiper blade according to the invention are possible by means of the measures disclosed in the remaining claims.

The wiping quality increases further if the proportion of the product of the contact force and the square of the length to the product of 48 times the elasticity modulus of the support element and the I_{zz} moment of inertia does not exceed an upper limit of 0.005.

Particularly useful cross sectional profiles are rectangular in design and have an essentially constant width and an essentially constant thickness over the length of the wiper blade. The support element can also be comprised of individual bars which are disposed laterally next to one another or one on top of another and their overall width or their overall thickness are respectively added together to produce an overall width and/or an overall thickness. With such a rectangular cross sectional profile, the moment of inertia I_{zz} can be entered as $d*b^3/12$, where the overall thickness and the overall width are entered as d and b, respectively. This produces an easy-to-apply relation via which the support element can be optimized for the wiper blades if the given upper limits of 0.009 and particularly 0.005 are not exceeded.

Particularly if more complex cross sectional profiles are chosen for the support element, which vary, for example, over the length of the wiper blade or have a ladder-type structure or the like, a favorable wiping quality can nevertheless be achieved if consideration is given to the fact that the lateral deflection angle γ does not exceed a

magnitude of 0.5° and in particular 0.3° during operation of the wiper blade. These specifications apply for an average friction value μ of 1 and must be correspondingly increased or decreased when there are higher or lower friction values.

The lateral deflection angle γ is the angle at which the tangent to the support element end intersects the axis extending in the longitudinal direction of the support element. In a first approximation, this angle can also be understood to be the angle enclosed by the axis extending in the longitudinal span direction of the support element and a straight line passing through a support element end and the fulcrum point of the wiper arm on the support element.

Very good wiping results can be achieved if the width b and the thickness d remain in a definite proportion to the

overall length of the support element. In particular, the product of the width and the square of the thickness should not exceed 40 times the square of the length and should not be less than 20 times the square of the length. The widths and/or the thicknesses of combined support elements are respectively added together to produce an overall width and overall thickness, which is then taken into consideration.

The wiper blade according to the invention has the advantage that only one parameter has to be varied in order to adjust the outwardly decreasing contact force distribution. The curvature or the curvature progression along the support element can be preset in freely programmable bending machines. As a result, short trial runs can also be carried out to optimize the contact force distribution and therefore the curvature progression rapidly and without a great deal of expense. It is particularly advantageous if the coordinate that governs the curvature progression extends along the inertial element. This eliminates the need for complex reverse calculations in a Cartesian coordinate system in which each change in a position x requires a shifting of the subsequent "x values".

The mathematical association between the second derivative of the curvature as a function of the adapted coordinate and the contact force progression likewise as a function of the adapted coordinate is particularly simple if the elasticity modulus of the support element material and the surface moment of inertia of the support element are constant over its length. With a preset contact pressure distribution, the curvature can then be directly calculated through double integration or also numerically.

An optimal adaptation of such a wiper blade to windows with a complex curvature progression is also possible if the curvature of the window is subtracted from the curvature of the support element or the second derivative of the curvature of the window is subtracted from the second derivative of the curvature of the support element. In this instance, a contact force distribution can be preset in the same way that is desirable for a wiper blade that is pressed against a flat window. The difference between the second derivatives of the respective curvatures is then once more proportional to this contact force distribution.

A wiper blade according to the invention excels in that without special adaptation, an excellent wiping result is achieved for average window types. The very simple steps taken result in the fact that the contact force distribution fulfills the requirements in most cases. The support points mentioned above are sufficiently precise to use as the basis for a curvature progression to be maintained.

Even with complex window curvature progressions, the wiping quality can be increased by presetting the contact force distribution to particular support points. It is nevertheless possible to design the wiper blade without complex calculations. The curvature progression can be essentially predetermined and can be optimized by means of simple trials. An excellent wiping quality is assured as long as the prerequisites are met that the contact force distribution that prevails when the wiper blade is pressed against the window to be wiped is greater in a region approximately halfway between the center and the end of the wiper blade than it is at the end of the wiper blade.

In a method according to the invention for producing such a wiper blade, the individual parameters are selected in accordance with the teaching according to the invention and the support element is pre-curved so that its curvature progression fulfills at least one of the conditions mentioned above. As a result, it is particularly favorable to bend the support element first and then to put it together with the wiper strip and the connecting element. However, it is also possible to attach the connecting element to the support element first and then to add the wiper strip.

DRAWINGS

FIG. **1** is a perspective representation of a wiper blade that is placed against the window and is connected to a wiper arm which is loaded toward the window,

FIG. **2** is a schematic side view of a wiper blade, which is placed in an unstressed state against the window, in a reduced scale compared to FIG. **1**,

FIG. **3** shows the sectional plane of an enlarged section through the wiper blade according to FIG. **1**, along the line III—III,

FIGS. **4** and **5** show a variant of FIG. **3**,

FIGS. **6** and **7** show a wiper blade in a different embodiment, with a coordinate system sketched in,

FIGS. **8** and **9** respectively show calculated and measured values for the contact force distribution plotted over the length of the wiper blade, and

FIG. **10** is a schematic side view, not to scale, of a support element belonging to'the wiper blade.

DESCRIPTION OF THE EXEMPLARY EMBODIMENT

A wiper blade **10** shown in FIG. **1** has an elongated, spring elastic support element **12**, which is also referred to as a flat bar, for a wiper strip **14**, which is shown separately in FIG. **10**. As shown in FIGS. **1**, **3**, and **4**, the support element **12** and the wiper strip **14** are connected to each other with their longitudinal axes parallel. On the top side of the support element **12** remote from the window **15** to be wiped—shown with dot-and-dash lines in FIG. **1**—, there is a connecting mechanism in the form of a connecting device **16** which can detachably connect the wiper blade **10** to a driven wiper arm **18** that is guided on the body of the motor vehicle. The elongated rubber elastic wiper strip **14** is disposed on the underside of the support element **12** oriented toward the window **15**.

A hook, which serves as a counterpart connection means, is formed onto the free end **20** of the wiper arm **18** and engages a pivot bolt **22** that is part of the connecting device **16** of the wiper blade **10**. The securing between the wiper arm **18** and the wiper blade **10** is achieved by an intrinsically known securing mechanism, which is not shown in detail and is embodied in the form of an adapter.

The wiper arm **18**, and therefore also its hook ends **20**, is loaded in the direction of the arrow **24** toward the window **15** to be wiped, whose surface to be wiped is indicated with a dot-and-dash line **26** in FIGS. **1** and **2**. The contact force F_{wf} (arrow **24**) places the wiper blade **10** with its entire length against the surface **26** of the window **15** to be wiped.

Since the dot-and-dash line **26** shown in FIG. **2** is intended to represent the sharpest curvature of the window surface in the vicinity of the wiping zone, it is clear that the curvature of the wiper blade **10**, which is as yet unstressed and rests with its two ends against the window, is sharper than the maximal curvature of the spherically curved window **15**. When the contact force F_{wf} (arrow **24**) is applied, the wiper blade **10** rests with its wiper lip **28**, which is part of the wiper strip **14**, over its entire length against the window surface **26**. This produces a tension in the band-like, spring elastic support element **12**, which ensures a proper contact of the wiper strip **14** or rather the wiper lip **28** over its entire length against the vehicle window **15**. During

wiper operation, the wiper arm **18** moves the wiper blade **10** lateral to its longitudinal span, across the window **15**. In FIG. **1**, this wiping or working motion is indicated by the double arrow **29**.

The particular embodiment of the wiper blade according to the invention will now be discussed in detail below. As shown in FIG. **3**, not to scale, the wiper strip **14** is disposed on the lower band surface of the support element **12**, oriented toward the window **15**. Spaced apart from the support element **12**, the wiper strip **14** is indented on its two longitudinal sides so that a tilting hinge **30** remains in its longitudinal center region, which extends over the entire length of the wiper strip **14**. The tilting hinge **30** transitions into the wiper lip **28**, which has an essentially wedge-shaped cross section. The contact force (arrow **24**) presses the wiper blade or rather the wiper lip **28** against the surface **26** of the window **15** to be wiped, and as a result of the wiping motion—of which FIG. **3** particularly shows the one of the two opposite wiping motions (double arrow **29**) indicated by the direction arrow **32**—the wiper lip **28** tilts into a so-called drag position, in which the wiper lip is supported along its entire length against the part of the wiper strip **14** that is secured to the support element **12**. This support, which is indicated with the arrow **34** in FIG. **3**, always takes place—depending on the respective wiping direction (double arrow **29** and arrow **32**, respectively)—against the upper edge of the wiper lip **28** disposed toward the rear in the respective wiping direction so that the wiper lip **28** is always guided across the window in a so-called drag position. This drag position is required for an effective, quiet operation of the wiper device. The reversal of the drag position takes place at the so-called reversal position of the wiper blade **10**, when the blade changes its wiping direction (double arrow **29**). As a result, the wiper blade executes an up and down motion which is necessitated by the tilting over of the wiper lip **28**. The upward motion occurs counter to the direction of the arrow **24** and consequently also counter to the contact force. In the opposite wiping direction from the arrow **32**, a mirror image of FIG. **3** is consequently produced.

FIG. **4**, which is an enlarged depiction in comparison to the wiper blade in FIG. **1**, shows a cross sectional profile **40** that has a rectangular sectional plane with a width b and a thickness d. In addition, a coordinate system is shown above the support element **12**. An s-coordinate, which follows the curvature of the support element **12**, is shown as a 3^{rd} coordinate in FIG. **6** and the y- and z-coordinates are perpendicular to it. If the wiper blade **10** is now pressed with a force F_{wf} (arrow **24**) against a window **26**, particularly by the wiper arm **18**, a certain force distribution p(s) is produced, which produces a moment M(s) that is maximal in the center of the support element **12**. For a constant contact force distribution

$$p = \frac{F_{wf}}{L}$$

which is favorable for the wiping operation, the moment is

$$M(s) = p * \frac{\left(\frac{L}{2} - s\right)^2}{2}$$

and consequently,

$$M(s) = F_{wf} * \frac{\left(\frac{L}{2} - s\right)^2}{2L}$$

For an outwardly decreasing contact force distribution, which is particularly suitable for tilting wiper lips over, the moment M(s) over its entire length is somewhat less than the moment calculated for a constant force distribution:

$$M(s) < p * \frac{\left(\frac{L}{2} - s\right)^2}{2}$$

If one then assumes that a friction value μ for a dry window is approximately 1, the lateral moment during operation is equal to the bending moment M(s), which in particular is a result of the preset force distribution p(s).

Based on the lateral bending moment, a lateral deflection angle γ can be inferred, which can be calculated by integration of the individual deflections from the fulcrum point of the wiper arm on the wiper blade to the wiper blade end. In the case of a centrally disposed connecting device **16**, the deflection angle is calculated according to the equation:

$$\gamma = \int_0^{L/2} \frac{M(s)}{E * I_{zz}} ds$$

In view of the relation of the moment for a constant contact force distribution, a simple estimate for the angle γ is obtained by:

$$\gamma < \int_0^{L/2} \frac{p(s)\left(\frac{L}{2} - s\right)}{2 * E * I_{zz}} ds$$

Integration yields the equation:

$$\gamma < \frac{p * L^3}{48 * E * I_{zz}} = \frac{F_{wf} * L^2}{48 * E * I_{zz}}$$

Among other things, the invention is based on the knowledge that a favorable wiping quality, particularly due to rattle prevention, is achieved if the angle γ does not exceed the value 0.5° (=0.009 rad) and in particular, 0.3° (=0.005 rad). As a result, a simple relation can be deduced between the contact force and the geometric dimensions of the wiper blade, according to which

$$\frac{F_{wf} * L^2}{48 * E * I_{zz}} < 0.009,$$

in particular <0.005.

For the most frequently occurring case of a rectangular profile **40**, as shown in FIGS. **8** and **9**, the moment of inertia is determined by:

$$I_{zz} = \frac{d * b^3}{12}$$

where

d=thickness of the support element

b=width of the support element.

The width b and the thickness d must therefore be selected so that

$$\frac{F_{wf} * L^2}{4 * E * d * b^3} < 0.009,$$

in particular <0.005.

If the support element **12** is divided into two separate spring bars **42** and **44**, as shown in FIG. **5**, then in the above considerations in the first approximation, the width b can be assumed to be the sum of the individual widths b1 and b2: $b=b_1+b_2$. Hence simple relations between the width and thickness of a support element can also be deduced for systems of this kind.

For the case in which a rectangular cross sectional profile is not selected, it is then necessary to determine the moment of inertia I_{zz} and to correspondingly insert it into the relations mentioned above. Likewise, cross sectional changes over the length of the wiper blade or a non-central fulcrum point of the wiper arm on the wiper blade must also be correspondingly taken into account in the above considerations.

In order to achieve the quietest possible tilting over of the wiper lip **28** from its one drag position into its other drag position, the support element **12** that is used to distribute the contact force (arrow **24**) is designed so that the contact force of the wiper strip **24**, or rather the wiper lip **28**, against the window surface **26** is greater in its middle section **36** than in at least one of the two end sections **38**.

The distribution of the contact force over the support element occurs as a function of various parameters of the support element such as the cross sectional profile, the cross sectional progression over the length of the support element, or also the radius progression R(s) along the support element. An optimization of the support element in the direction of a predetermined contact force distribution p(s) is therefore very complex. The invention is based on the knowledge that in a support element with an essentially constant, in particular rectangular cross section over the length of the support element, the contact force distribution p(s) can-be established by predetermining the curvature K along a coordinate s, which coordinate s extends along the support element. The curvature K(s) is equal to the inverse radius as a function of s:

$$K(s) = \frac{1}{R(s)}$$

In the support element, there is a relation between the bending moment M, the radius R of the support element, its elasticity modulus E, and the surface moment of inertia I prevailing at the respective location. The relation is particularly simple when it is related to the coordinate s, which adapts along with the support elements:

$$K(s) = \frac{M(s)}{E * I}$$

Double differentiation as a function of the location s yields the relation:

$$\frac{d^2 K(s)}{ds^2} = \frac{d^2 M(s)/ds^2}{E * I}$$

Since the second derivative of the bending moment M as a function of the adaptive coordinate s is equal to the contact force distribution d along the coordinate s, which arises when the support element is pressed against a window, then it follows from this that the second derivative of the curvature K as a function of the adaptive coordinate s coincides with this contact force distribution p against a flat window, with the exception of a constant. The constant depends on the elasticity modulus E as well as on the surface moment of inertia I which for its part, is very simple if the cross section in question is rectangular. When there is a preset, outwardly decreasing contact force distribution p, the curvature profile K(s) can be determined mathematically or by simple experimentation. The geometry and therefore the parameters of the support element that are required for manufacture are therefore easy for a specialist to determine.

In order to take into account the shape of the window for which the wiper blade should be used, the above relation should be adjusted such that based on the contact force distribution p along the coordinate s—which distribution is predetermined for a flat window, decreases toward the outside, and is also divided by the elasticity modulus E and the surface moment of inertia I—, the second derivative of the curvature K_{window} of the window as a function of the coordinate s must be added to it:

$$\frac{d^2 K(s)}{ds^2} = \frac{p(s)}{E * I} + \frac{d^2 K_{window}(s)}{ds^2}$$

By means of this, it is also easy for the specialist to configure a support element for a particular window:

- determination of the length L and the cross sectional profile, particularly the width b and the thickness d by means of experimental values,
- determination of a contact force F_{wf} and a contact force distribution p for a flat window, which assures a favorable wiping quality, likewise by means of experimental values,
- measurement of the curvature progression K_{window} of the window,
- double derivation of this curvature progression K_{window} Of the window as a function of a coordinate that adapts along with the curvature,
- calculation of the second derivative of the curvature progression K(s) of the support element according to the above relation,
- double integration yields the desired curvature progression K(s) of the support element. It has turned out that favorable wiping results can be achieved if the curvature K along the adaptive coordinate a is such that the contact force distribution, which prevails when the wiper blade is pressed against a flat window, is greater than in a region approximately halfway between the center and the end of the wiper blade than it is at the end of the wiper blade. FIGS. **8** and **9** show this region **50** for one side. The invention is based on the knowledge is of less significance than the relation between e that the progression of the contact force distribution p in the region **50** to the contact force distribution p at the ends of the wiper blade. The overall length L of a wiper blade is plotted in FIGS. **8** and **9**, respectively, in which

the connecting element **16** is disposed in the center of the wiper blade so that the wiper blade ends each occupy the value 0.5 L.

Very favorable wiping results are achieved if the curvature K along a coordinate s that follows the longitudinal span of the support element **12** has values such that the contact force distribution p that prevails when the wiper blade is pressed against the window to be wiped is greater in the region approximately halfway between the center and the end of the wiper blade than it is at the end of the wiper blade. Although taking into account the window shape for which the wiper blade is provided does in fact limit the blade's general suitability for arbitrary window types, it also results in the fact that the selected window is wiped in an optimal manner.

FIG. **10** depicts a possible curvature progression K of the support element **12**, which can produce a contact force distribution p of the wiper lip **28** against the window **15**, which decreases toward the wiper blade end. With this spring elastic support element **12** which, when unstressed, has a sharper hollow curvature toward the window than this window has in the vicinity of the wiping zone swept by the wiper blade, the curvature progression K is designed so that it is sharper in the middle section **36** of the support element **12** than in its end sections **38**.

Reducing the contact force of the wiper lip **28** against the window surface **26** in the vicinity of one wiper blade end or at both wiper blade ends prevents the wiper lip **28** from abruptly flipping over or snapping over as it moves from its one drag position into its other drag position. On the contrary, with the wiper blade according to the invention the wiper lip turns over in a comparatively gentle manner, starting from the end of the wiper blade, moving to the center of the wiper lip, and continuing on to the other end of the wiper lip. In combination with FIG. **1**, FIG. **3** shows that even with spherically curved windows, the less intensely stressed end sections of the wiper lip **28** still rest against the window surface in an effective manner.

It is common to all of the exemplary embodiments that the contact force (arrow **24**) of the wiper strip **14** against the window **15** is greater in its middle section **36** than in at least one of its two end sections **38**. This is also the case when—in contrast to the wiper blade **10** graphically represented, with a one-piece support element **12** depicted as a spring strip—the support element is embodied as having several parts. In certain circumstances, however, it can also be necessary to preset other contact force distributions. But even then, wiper blades which produce excellent wiping results can be designed using the relations demonstrated.

As has already been indicated above, with the method according to the invention for producing a wiper blade, first the contour and the curvature progression K are determined and then the support element **12** is put together with the wiper strip **14** and the connecting element **16**. If the support element is comprised of two parallel, flat bars, these can preferably be pre-curved with each other, i.e. directly next to each other, which assures a very symmetrical and therefore torsionally stable design of the wiper blade. Later in the process, the two support element halves must then be further processed in order to prevent an inadvertent separation. After the support element has been curved, either the wiper blade is first mounted, for example by means of being glued in place or vulcanized in place, or in particular, when there are two support element halves, by means of insertion of the support element halves into longitudinal grooves of the wiper strip, and then the connecting element is mounted. In particular, if the connecting element is welded on, the wiper strip must only be attached afterward in order to avoid thermal damage to the wiper rubber.

What is claimed is:

1. A wiper blade for windows, comprising:

at least one support element **(12)**, a wiper strip **(14)**, and a connecting device **(16)** for a wiper arm **(18)**, wherein the support element **(12)** is an elongated, flat bar to which the wiper strip **(14)** and the connecting device **(16)** are attached, wherein the support element **(12)** has a cross sectional profile in which

$$\frac{F_{wf} * L^2}{48 * E * I_{zz}} < 0.009,$$

where F_{wf} is an actual contact force exerted on the wiper blade by the wiper arm **(18)** in condition when it is pressed against a window, L is a length of the support element **(12)**, E is an elasticity modulus of the support element **(12)**, and I_{zz} is a moment of inertia of a cross sectional profile around a z-axis perpendicular to an taxis, which adapts along with the support element **(12)**, and perpendicular to a y-axis, wherein the support element **(12)** has a substantially rectangular cross sectional profile **(40)**, with a substantially constant width b and a substantially constant thickness d.

2. The wiper blade according to claim **1**, wherein

$$\frac{F_{wd} * L^2}{48 * E * I_{zz}} < 0.005.$$

3. The wiper blade according to claim **1**, wherein the support element **(12)** is comprised of at least two individual bars **(42, 44)** and wherein widths (b1, b2) of the individual bars **(42, 44)** add up to a total width b.

4. A wiper blade for windows **(15)**, comprising:

at least one elongated support element **(12)**, a wiper strip **(14)**, and a connecting device **(16)** for a wiper arm **(18)** which presses the wiper blade **(10)** against the window **(15)** in an operating position, wherein the support element **(12)** is an elongated, flat bar to which the wiper strip **(14)** and the connecting device **(16)** are attached, and which has a curvature when it is not loaded by the wiper arm **(18)**, wherein the curvature along a coordinate (s), which follows a longitudinal span of the support element **(12)**, has values such that a second derivative of the curvature as a function of this coordinate (s) is essentially proportional to a contact force distribution p (s), which is produced when the wiper blade **(10)** is pressed against a flat window **(15)**, and wherein the contact force distribution decreases toward at least one end, wherein the support element **(12)** has a substantially rectangular cross sectional profile **(40)**, with a substantially constant width b and a substantially constant thickness d.

5. The wiper blade according to claim **4**, wherein

$$\frac{d^2 K(s)}{ds^2} = \frac{d^2 M(s)}{ds^2} * E * I = \frac{p(s)}{E * I}$$

s=coordinate along the support element

K(s)=curvature of the support element

M(s)=bending moment

E=elasticity modulus

I=surface moment of inertia of the support element in relation to a neutral axis

p(s)=specific force per unit length=contact force distribution.

6. A wiper blade for windows (**15**), comprising:

at last one elongated support element (**12**), a wiper strip (**14**), and a connecting device (**16**) for a wiper arm (**18**) which presses the wiper blade (**10**) against the window (**15**) in an operating position, wherein the support element (**12**) is an elongated, flat bar to which the wiper strip (**14**) and the connecting device (**16**) are attached, and which has a curvature when it is not loaded by the wiper arm (**18**), wherein the curvature along a coordinate (s), which follows a longitudinal span of the support element (**12**), has values such that a second derivative of the curvature as a function of this coordinate (s) minus the second derivative of the curvature of the window (**15**) decreases from a middle region (**40**) toward end regions, wherein the support element (**12**) has a substantially rectangular cross sectional profile (**40**), with a substantially constant width b and a substantially constant thickness d.

7. The wiper blade according to claim **6**, wherein the middle region (**40**) is a location of the connecting device (**16**).

8. The wiper blade according to claim **6**, wherein

$$\frac{d^2K(s)}{ds^2} = \frac{p(s)}{E*I} + \frac{d^2K_{window}(s)}{ds^2}$$

s=coordinate along the support element

K(s)=curvature of the support element

M(s)=bending moment

E elasticity modulus

I=surface moment of inertia of the support element in relation to a neutral axis

p(s)=specific force per unit length=contact force distribution.

9. A wiper blade for windows (**15**), comprising:

at least one elongated support element (**12**), a wiper strip (**14**), and a connecting device (**16**) for a wiper arm (**18**) which presses the wiper blade (**10**) against the window (**15**) in an operating position, wherein the support element (**12**) is an elongated, flat bar to which the wiper strip (**14**) and the connecting device (**16**) are attached, and which has a curvature when it is not loaded by the wiper arm (**18**), wherein the curvature along a coordinate (s), which follows a longitudinal span of the support element (**12**), has values such that a contact force distribution p(s), which prevails when the wiper blade (**10**) is pressed against a flat window (**15**) is greater in a region (**40**) approximately halfway between a center and an end of the wiper blade (**10**) than it is at the end of the wiper blade (**10**), wherein the support element (**12**) has a substantially rectangular cross sectional profile (**40**), with a substantially constant width b and a substantially constant thickness d.

10. A method for producing a wiper blade assembly according to claim **1**, comprising the following steps:

determining the length L and adapted contact force F_{wf} required for the window to be wiped,

determining a width b and a thickness d,

determining a curvature progression K(s),

bending the support element,

connecting the supporting element, wiper strip, and connecting device.

11. The method according to claim **10**, comprising the following steps:

determining the length L and the cross sectional profile, particularly the width b and the thickness d by means of experimental values,

determining a contact force F_{wf} and a contact force distribution p for a flat window, which assures a favorable wiping quality, likewise by means of experimental values,

measuring the curvature progression K_{window} of the window,

double derivation of this curvature progression K_{window} of the window as a function of a coordinate that adapts along with the curvature,

calculating the second derivative of the curvature progression K(s) of the support element according to an above relation,

double integration yields a desired curvature progression K(s) of the support element.

* * * * *

EXHIBIT F

US006973698B1

(12) **United States Patent**
Kotlarski

(10) **Patent No.: US 6,973,698 B1**
(45) **Date of Patent: Dec. 13, 2005**

(54) **WIPER BLADE FOR MOTOR VEHICLE WINDOWS**

(75) Inventor: **Thomas Kotlarski**, Buehlertal (DE)

(73) Assignee: **Robert Bosch GmbH**, Stuttgart (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 100 days.

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§ 371 (c)(1),
(2), (4) Date: **Feb. 18, 2000**

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PCT Pub. Date: **Oct. 14, 1999**

(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**[7] **B60S 1/38**
(52) **U.S. Cl.** **15/250.43**; 15/250.451
(58) **Field of Search** 15/250.43, 250.44, 15/250.361, 250.451, 250.48

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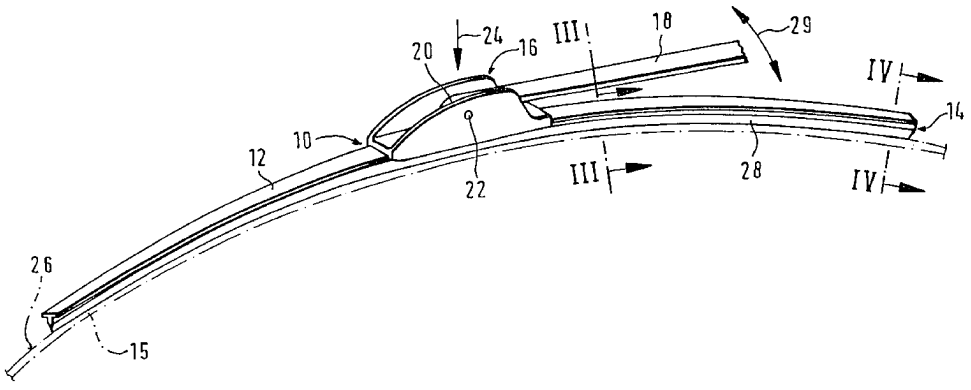
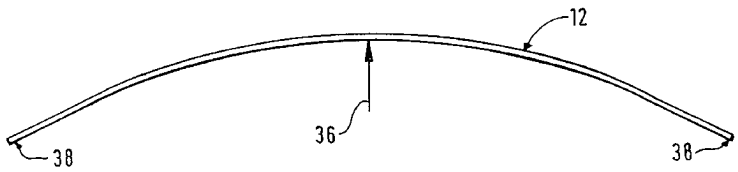
(74) *Attorney, Agent, or Firm*—Michael J. Striker

(57) **ABSTRACT**

A wiper device with a wiper blade for cleaning windows of motor vehicles, in which the wiper blade can be moved back and forth laterally to its longitudinal span by a driven wipe arm which can be connected to the wiper blade and loads the same against the window. The wiper blade has an elongated wiper strip that can be placed against the window and an elongated spring-elastic carrying element, which has a connecting unit for the wiper arm and is disposed parallel to the longitudinal axis of the wiper strip to distribute a contact force over the entire wiper strip length. A particularly effective and low-noise operation of the wiper system is achieved because the contact force of the wiper strip against the window is greater in its center section than in at least one of two end sections of the wiper strip.

1 Claim, 3 Drawing Sheets





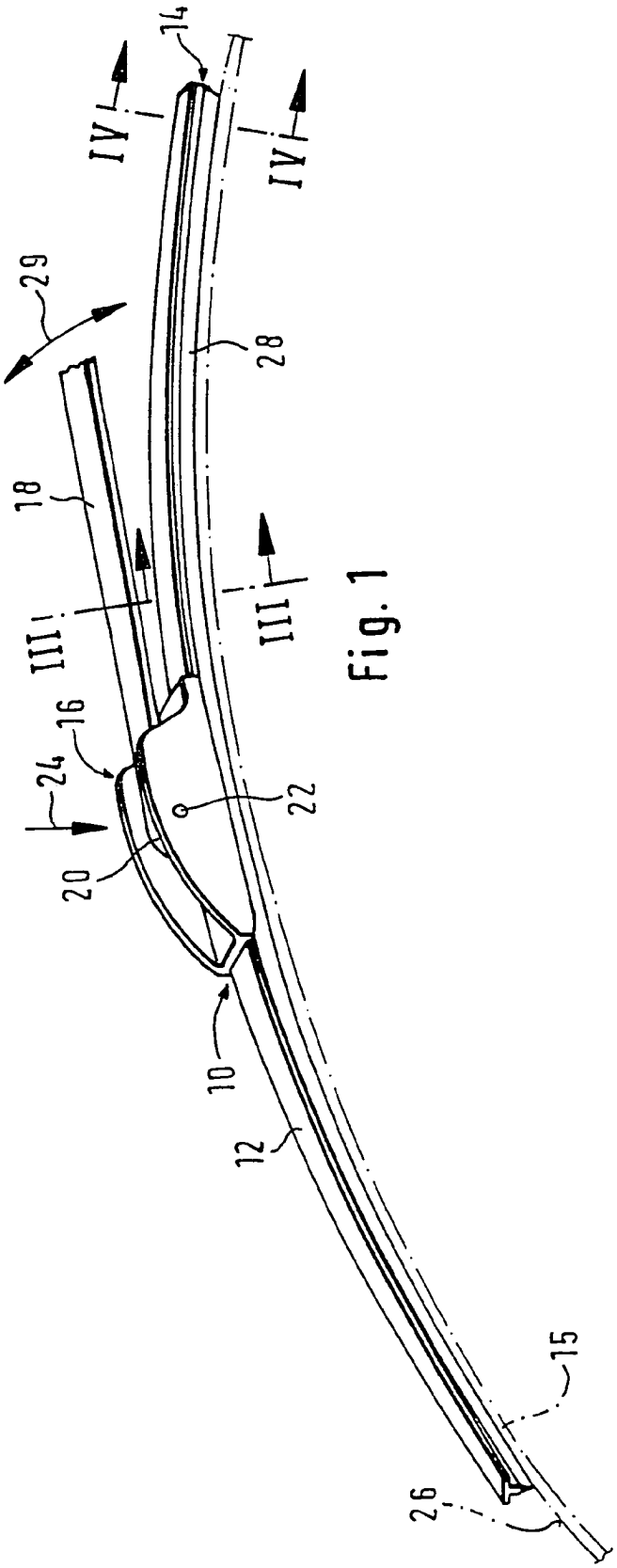


Fig. 1

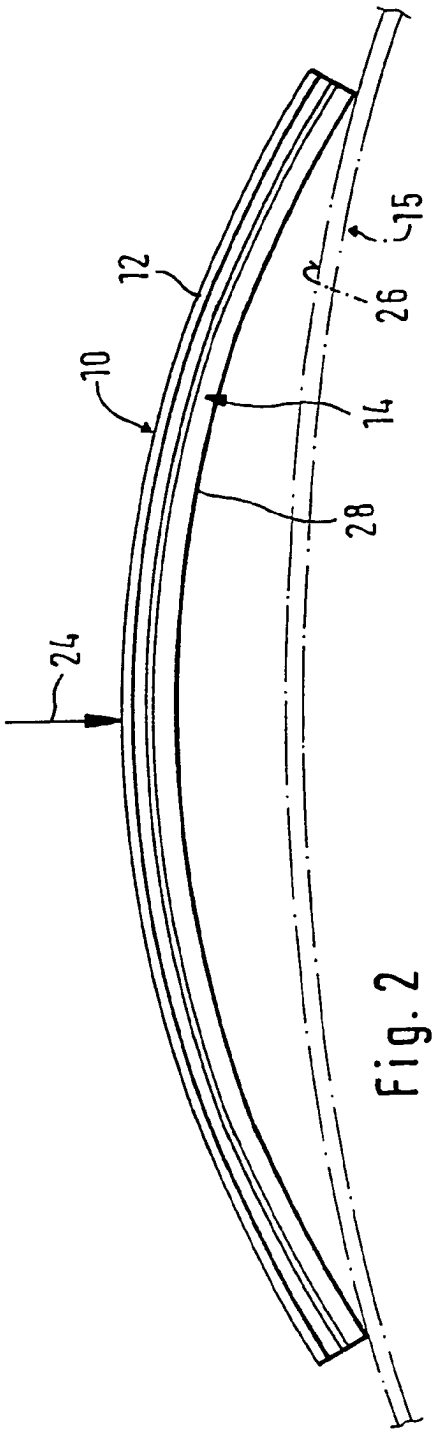


Fig. 2

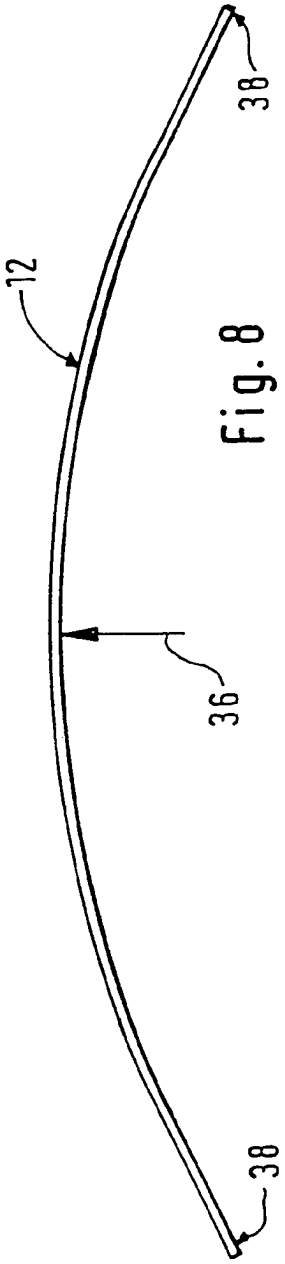


Fig. 8

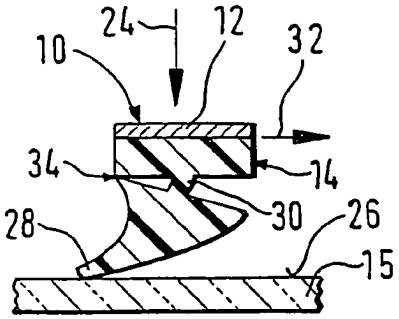


Fig. 3

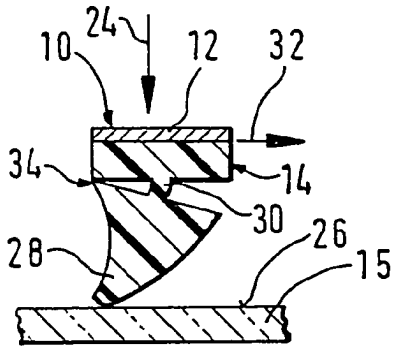


Fig. 4

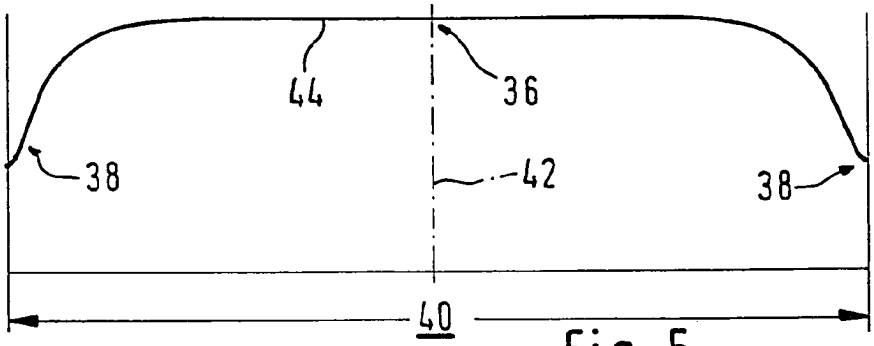


Fig. 5

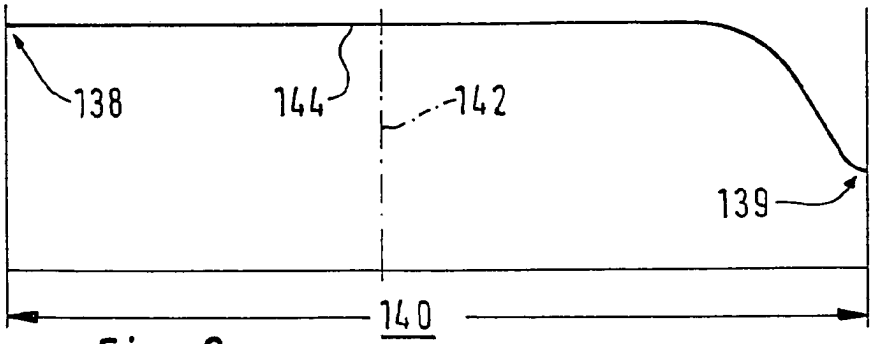


Fig. 6

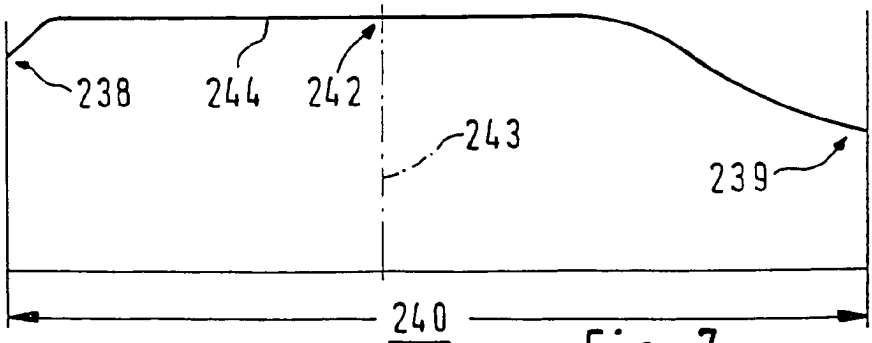


Fig. 7

WIPER BLADE FOR MOTOR VEHICLE WINDOWS

This application is a 371 of PCT/DE98/03721 filed Dec. 18, 1998.

PRIOR ART

In wiper blades of the type under consideration, the carrying element is intended to assure a predetermined distribution of the wiper arm-induced wiper blade pressing force—often also called pressure—against the window over the entire wiping field swept across by the wiper blade. Through a corresponding curvature of the unstressed carrying element—i.e. when the wiper blade is not resting against the window—the ends of the wiper strip, which is placed completely against the window during the operation of the wiper blade, are loaded toward the window by the carrying element which is then stressed, even when the curvature radii of spherically curved vehicle windows change with each wiper blade position. The curvature of the wiper blade must therefore be slightly sharper than the sharpest curvature measured in the wiping field on the window to be wiped. The carrying element consequently replaces the expensive support bracket construction with two spring rails disposed in the wiper strip, as is the practice in conventional wiper blades (published, non-examined German patent application 15 05 357).

In a known wiper blade of this type (German patent 12 47 161), in order to produce as uniform as possible a pressure loading of the wiper blade against a flat window over its entire length, a number of embodiments of the carrying element are provided.

In another known wiper blade according to the preamble to claim **1** (EP 05 28 643 B1), in order to produce a uniform pressure loading of the wiper blade against spherically curved windows, the pressure loading at the two end sections increases significantly when the wiper blade is pressed against a flat window.

The uniform pressure distribution over the entire wiper blade length desired in both instances, however, causes the wiper lip, which belongs to the wiper blade and does the actual wiping work, to abruptly flip over along its entire length from its one drag position into the other when the wiper blade reverses its working direction. This drag position is essential for an effective and low-noise operation of the wiper system. However, the abrupt flipping over of the wiper lip—which is inevitably connected with a back and forth movement of the wiper blade—produces undesirable knocking noises. Also, the matching of the carrying element stress to the desired pressure distribution, which is different from case to case, is problematic in the case of spherically curved windows.

SUMMARY OF THE INVENTION

According to the present invention, a wiper blade which can be moved back and forth across the window comprises an elongated wiper strip, and a spring-elastic carrying element wherein a contact force of the wiper strip against the window is greater in its center section then in at least one of two end sections thereof. In the wiper blade according to the present invention, in the vicinity of the reduced contact force, a steeper drag position of the wiper lip is produced in comparison to the region with the greater contact force. This steeper position of the wiper lip encourages its tilting-over process in the wiping direction reversal positions of the wiper blade, which is initiated there and then continued in the region that has the greater contact force. This prevents the abrupt snapping over of the entire wiper lip and the unpleasant knocking noise connected with it. This also eliminates the problems in the design of the carrying element with regard to the contact pressure distribution in spherically curved windows. Namely, it has turned out that the reduction of the contact pressure at the end section of the wiper blade does not inevitably also attend a reduction in the wiping quality.

It is particularly advantageous if the contact pressure of the wiper strip against the window is lower at its two end sections than in its center section because the tilting-over process of the wiper lip then takes place starting from both ends and is therefore finished more quickly.

With particularly problematic window curvatures, it can be useful if the contact pressure of the wiper strip against a window in its center section is at least almost uniform in magnitude and decreases at the end section(s).

A preferred embodiment of the carrying elements for achieving the desired distribution of the contact pressure provides that the carrying element has a concave curvature on its side oriented toward the window which is sharper than the sharpest curvature of the spherically curved window in the vicinity of the wiping field that can be swept across by the wiper blade and that the concave curvature in the center section of the carrying element is sharper than that of its end section(s).

Other advantageous embodiments and updates of the invention are disclosed in the following description of an exemplary embodiment shown in the respective drawings.

DRAWINGS

FIG. **1** is a perspective depiction of a wiper blade that is resting against the window and is connected to a wiper arm that is loaded in the direction of the window,

FIG. **2** is a schematic representation of a side view of an unloaded wiper blade placed against the window, shown at a reduced scale in comparison to FIG. **1**,

FIG. **3** shows the sectional plane of the section through the wiper blade according to FIG. **1**, along the line III—III in an enlarged depiction,

FIG. **4** shows the sectional plane of a section through the wiper blade according to FIG. **1** along the line IV—IV in an enlarged depiction,

FIG. **5** is a graphic representation of the wiper blade contact pressure over the wiper blade length according to a first possible embodiment of the invention,

FIG. **6** is a graphic representation of the wiper blade contact pressure over the wiper blade length according to a different possible embodiment of the invention,

FIG. **7** is a graphic representation of the wiper blade contact pressure over the wiper blade length according to another possible embodiment of the invention, and

FIG. **8** is a schematic representation, not to scale, of a side view of a carrying element belonging to the wiper blade.

DESCRIPTION OF THE EXEMPLARY EMBODIMENT

A wiper blade **10** shown in FIG. **1** has an elongated, spring-elastic carrying element **12** for a wiper strip **14**, and this carrying element **12** is shown separately in FIG. **8**. As can be seen from FIGS. **1**, **3**, and **4**, the carrying element **12** and the wiper strip **14** are connected to each other so that their longitudinal axes are parallel. A connecting device **16**

is disposed on the top side of the carrying element **12** remote from the window **15** to be wiped—indicated with dot-and-dash lines in FIG. **1**—and with the aid of this connecting device **16**, the wiper blade **10** can be detachably connected to a driven wiper arm **18** that is supported on the body of a motor vehicle. The elongated, rubber-elastic wiper strip **14** is disposed on the underside of the carrying element **12** oriented toward the window **15**. A hook, which is used as a reciprocal connecting means, is formed onto the free end **20** of the wiper arm **18** and encompasses a pivot bolt **22** belonging to the connecting device **16** of the wiper blade **10**. The retention between the wiper arm **18** and the wiper blade **10** is performed by an intrinsically known securing means that is embodied as an adapter and is not shown in detail. The wiper arm **18** and therefore also its hook end **20** are loaded in the direction of the arrow **24** in relation to the window **15** to be wiped, whose surface to be wiped is indicated in FIGS. **1** and **2** by means of a dot-and-dash line **26**. The force (arrow **24**) places the wiper blade **10** over its entire length against the surface **26** of the window **15** to be wiped. Since the dot-and-dash line **26** depicted in FIG. **2** is intended to represent the sharpest curvature of the window surface in the region of the wiping field, it is clearly evident that the curvature of the as yet unloaded wiper blade **10** resting with both of its ends against the window is sharper than the maximal curvature of the spherically curved window **15**. Due to the pressure (arrow **24**), the wiper blade **10** rests over its entire length against the window surface **26** with its wiper lip **28** that belongs to the wiper strip **14**. This produces a stress in the band-like spring-elastic carrying element **12**, which assures a proper contact of the wiper strip **14** or the wiper lip **28** over its entire length against the motor vehicle window **15**. During wiper operation, the wiper arm **18** moves the wiper blade **10** lateral to its longitudinal span, across the window **15**. This wiping or working motion is indicated in FIG. **1** with the double arrow **29**.

The particular embodiment of the wiper blade according to the invention will now be discussed in detail. As shown by the not-to-scale FIGS. **3** and **4**, the wiper strip **14** is disposed on the lower band surface of the carrying element **12** oriented toward the window **15**. Spaced apart from the carrying element **12**, the wiper strip **14** is constricted from its two long sides in such a way that a tilting piece **30** remains in its longitudinal center region and extends over the entire length of the wiper strip **14**. The tilting piece **30** transitions into the wiper lip **28**, which has an essentially wedge-shaped cross section. Because of the contact force (arrow **24**), the wiper blade or the wiper lip **28** is pressed against the surface **26** of the window **15** to be wiped, wherein due to the influence of the wiping movement—one of the two opposing wiping motions (double arrow **29**) in particular is considered in FIGS. **3** and **4** and is indicated by the direction arrow **32**—, this wiper lip **28** tilts into a so-called drag position in which the wiper lip is supported over its entire length against the part of the wiper strip **14** that is secured to the carrying element **12**. This support, which is indicated in FIGS. **3** and **4** with the arrow **34**, is always produced—depending on the respective wiping direction (double arrow **29** or arrow **32**)—against the upper edge of the wiper lip **28** disposed toward the rear in the respective wiping direction so that it is always guided across the window in a so-called drag position. This drag position is required for an effective and low-noise operation of the wiper apparatus. The reversal of the drag position takes place in the so-called reversal position of the wiper blade **10** when this reverses its wiping motion (double arrow **29**). The wiper blade executes a back and forth motion, which is induced by the tilting over of the wiper lip **28**. The upward motion occurs counter to the direction **24** and consequently also counter to the contact force. In the other wiping direction directed counter to the arrow **32**, a mirror image of the FIGS. **3** and **4** is consequently produced.

In order to produce as low-noise as possible a tilting over of the wiper lip **28** from its one drag position into its other drag position, the carrying element **12** used for distributing the contact force (arrow **24**) is designed so that the contact force of the wiper strip **24** or the wiper lip **28** against the window surface **26** is greater in its center section **36** (FIG. **8**) than in at least one of the two end sections **38**. This fundamental concept, for example, can be incorporated, as shown in a graphic representations according to FIGS. **5** to **7**.

According to FIG. **5**, the carrying element **12** is designed so that viewed in terms of the length **40** of the wiper blade, its center region **36** has a virtually uniform contact force (line **44**) and that this contact force **44** sharply decreases at both end sections **38** of the wiper blade. The dot-and-dash line **42** is intended to indicate a possible position of the pivot bolt **22**, i.e. the engagement point of the wiper arm-induced contact force.

In another embodiment (FIG. **6**), the carrying element **12** is designed so that viewed in terms of the length **140** of the wiper blade, starting from the one and **138** of the wiper blade until well beyond its linkage point (line **142**), the contact force **24** is of a uniform magnitude (line **144**) until it decreases sharply in the region of the other and **139** of the wiper blade. The possible linkage point of the wiper blade to the wiper arm has been labeled **142** in FIG. **6**.

Another possible design of the wiper blade according to the invention, which is shown in FIG. **7**, provides that the contact pressure or contact force (**244**) of the wiper lip **28** against the window surface **26** is essentially uniform in the center region **242** of the wiper blade—where the linkage point of the wiper arm **18** is disposed—and that it decreases slightly toward one and **238** of the wiper blade whereas it decreases considerably in the vicinity of the other and **239** of the wiper blade. With this design of the wiper blade, the engagement point **243** of the wiper arm **18**, is disposed on the wiper blade outside the center of the wiper blade length **240**, as in the design according to FIG. **6**. Naturally, it is possible to use such a positioning of the linkage point even in wiper blades that are designed in accordance with FIG. **5**. The different designs of the wiper blade can be required by particular window types, which differ from one another, for example due to the type of spherical curvatures of the windows.

FIG. **8** shows a possible curvature course of the carrying element **12**, which can produce a pressure distribution of the wiper lip **28** against the window **15**, as is graphically depicted in FIG. **5**. With this spring-elastic carrying element **12**, which when unloaded has a sharper concave curvature than the window in the region of the wiping field being swept across by the wiper blade, the curvature course is embodied so that it is sharper in the center section **36** of the carrying element than at its end sections **38**. In order to achieve the desired contact force distribution, however, it is also conceivable to reduce the end sections **38** of the carrying element **12** cross sectionally so that a comparable effect is achieved.

Naturally, this possibility can also be combined with correspondingly coordinated changes in the curvature course of the carrying element **12**.

The reduction of the contact force of the wiper lip **28** against the window surface **26** in the region of one or both

wiper blade ends, prevents an abrupt flipping over or snapping over of the wiper lip **28** from its one drag position into its other drag position. In contrast, with the wiper blade according to the invention, a comparatively gentle tilting over of the wiper lip is produced, starting from the wiper blade end and continuing to the wiper lip center or to the other wiper lip end. FIGS. **3** and **4**, in connection with FIG. **1**, show that even with spherically curved windows, the less-loaded end sections of the wiper lip **28** still rest effectively against the window surface. A comparison of FIGS. **3** and **4** shows this, from which it is clear that in the less-loaded end region (FIG. **4**), the wiper lip **28** is disposed more steeply in relation to the window surface **26** than in its center section (FIG. **3**), where the greater contact force is in effect. This steeper disposition of the wiper lip **28** encourages the beginning of the tilting over of the wiper lip when the reverse motion of the wiping motion begins (double arrow **29**).

It is common to all of the exemplary embodiments that the contact pressure (arrow **24**) of the wiper strip **14** against the window **15** is greater in its center section **36** than in at least one of its two end sections **38**. This is true even if in contrast to the currently shown wiper blade **10** with a one-piece carrying element **12** depicted as a spring rail, the carrying element is embodied as having a number of parts. The only crucial thing is the distribution of the contact pressure according to the invention.

What is claimed is:

1. A wiper blade for a wiping device of a motor vehicle for wiping a window of the motor vehicle, comprising an elongated wiper strip placeable against the window, and an elongated spring-elastic carrying element disposed on a side of the wiper strip remote from the window, said spring-elastic carrying element extending parallel to an axis of elongation of said wiper strip to distribute a contact force against the window over an entire length of said wiper strip, said wiper strip having a center section and two end sections, said contact force of said wiper strip being greater in said center section than in at least one of said two end sections, said spring-elastic carrying element has on a side thereof oriented toward the window a concave curvature that is sharper than the sharpest curvature of a spherically curved window in a region of a wiping field that can be swept across by said wiper blade and a concave curvature in said center section of the carrying element is sharper than in said sections thereof.

* * * * *

EXHIBIT G

US006944905B2

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De Block et al.

(10) **Patent No.: US 6,944,905 B2**
(45) **Date of Patent: Sep. 20, 2005**

(54) **WIPER BLADE FOR CLEANING SCREENS IN PARTICULAR ON MOTOR VEHICLES**

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(73) Assignee: **Robert Bosch GmbH**, Stuttgart (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 313 days.

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§ 371 (c)(1),
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(52) **U.S. Cl.** **15/250.201**; 15/250.43
(58) **Field of Search** 15/250.201, 250.43, 15/250.44, 250.361, 250.48

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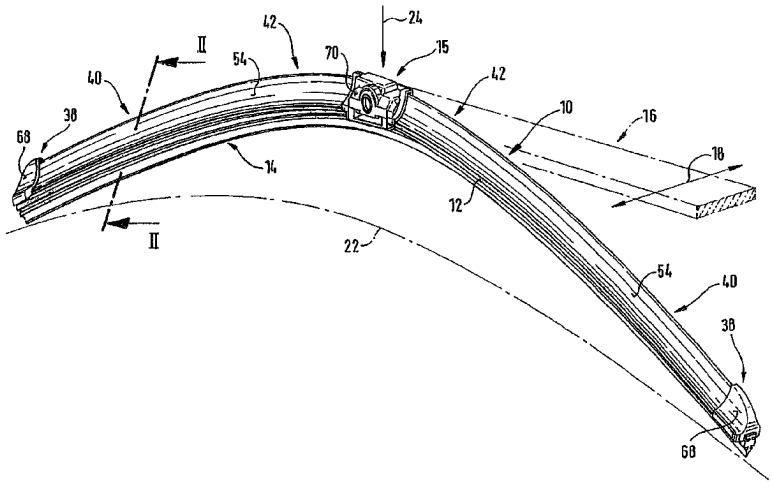
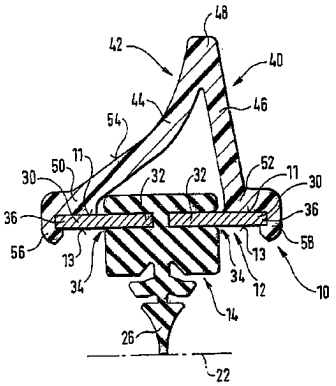
(74) *Attorney, Agent, or Firm*—Michael J. Striker

(57) **ABSTRACT**

A wiper blade for cleaning motor vehicles is proposed, which is provided with a band-like, elongated, spring-elastic support element (**12**). The lower band surface (**13**) of the support element (**12**) oriented toward the window (**22**) has an elongated, rubber-elastic wiper strip (**14**), which can be placed against the window (**22**), disposed on it so that the longitudinal axes of these two parts are parallel and the upper band surface (**11**) of the support element (**12**) has a wind deflection strip (**42**) disposed on it, which extends in the longitudinal direction of the support element, is provided with an attack surface (**54**) oriented toward the main flow of the relative wind, and is comprised of an elastic material. A considerable weight savings for the wiper blade is achieved if the wind deflection strip (**42**, **142**, or **242**) has two diverging legs (**44**, **46**), viewed in cross section, which are connected to each other at a common base (**48**) and whose free ends (**50**, **52**) oriented toward the window (**22**) are supported on the wiper blade (**10**), and the attack surface (**54**) is embodied on the outside of the one leg (**44**).

19 Claims, 4 Drawing Sheets





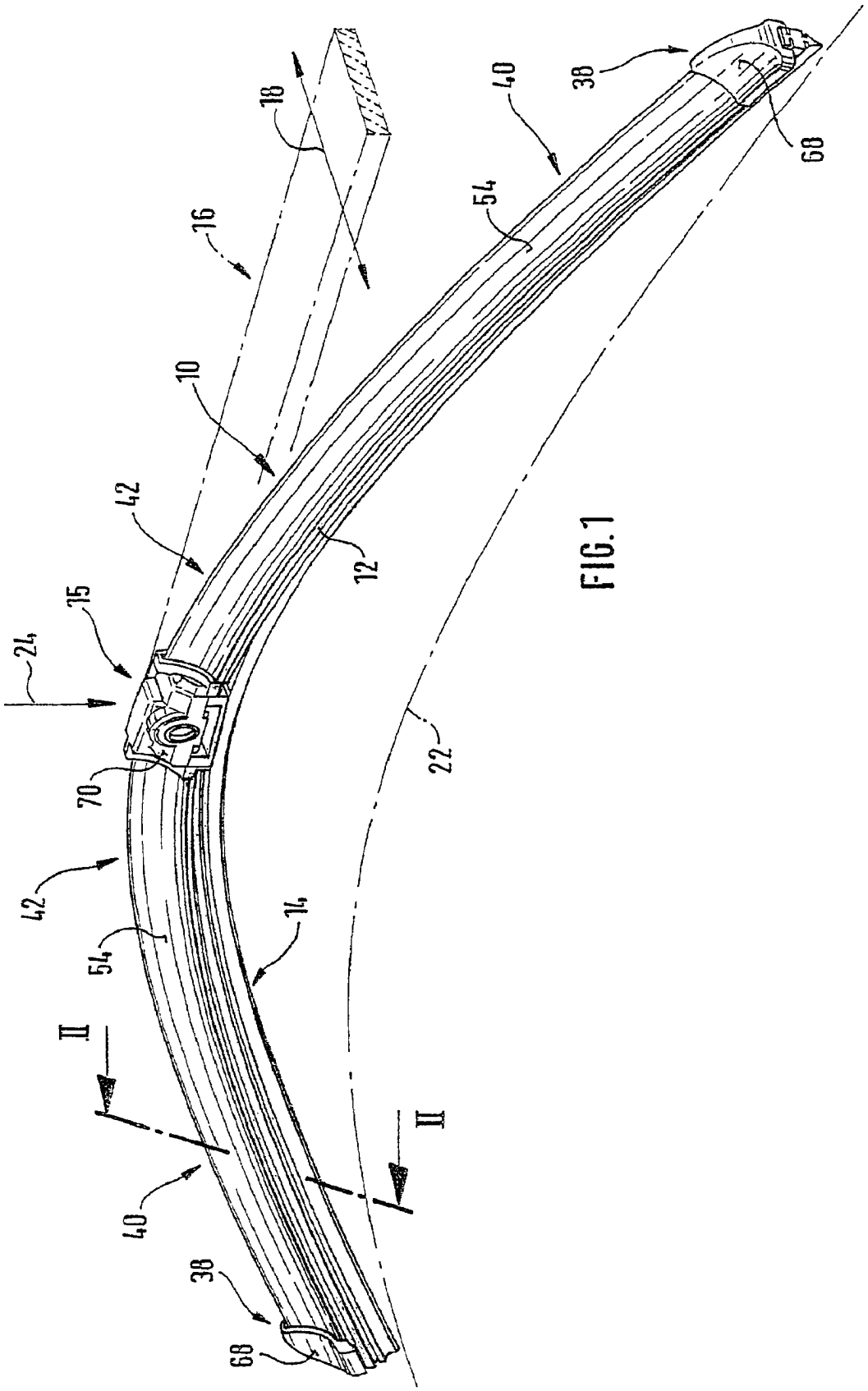
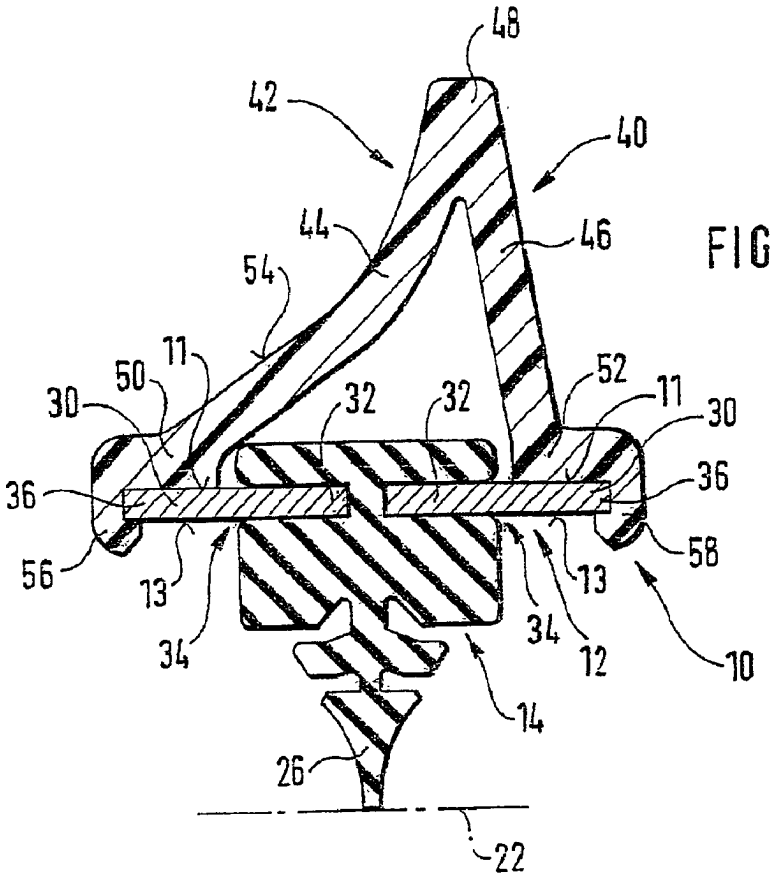


FIG. 1


48
42
40
44
46
54
11
50
30
32
32
52
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30
36
36
56
13
34
34
12
13
58
10
14
26
22

FIG. 2

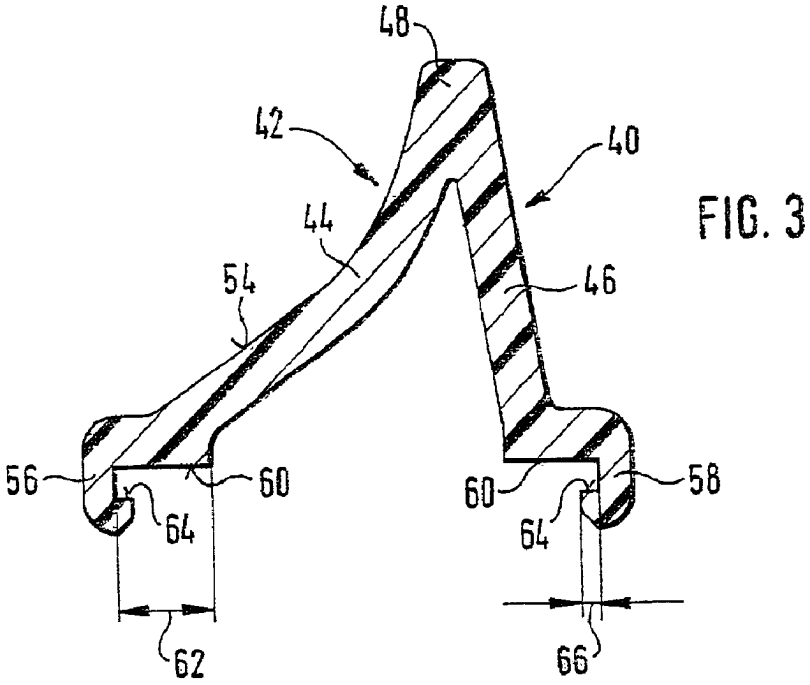
48
42
40
44
54
46
56
60
60
58
64
64
62
66

FIG. 3

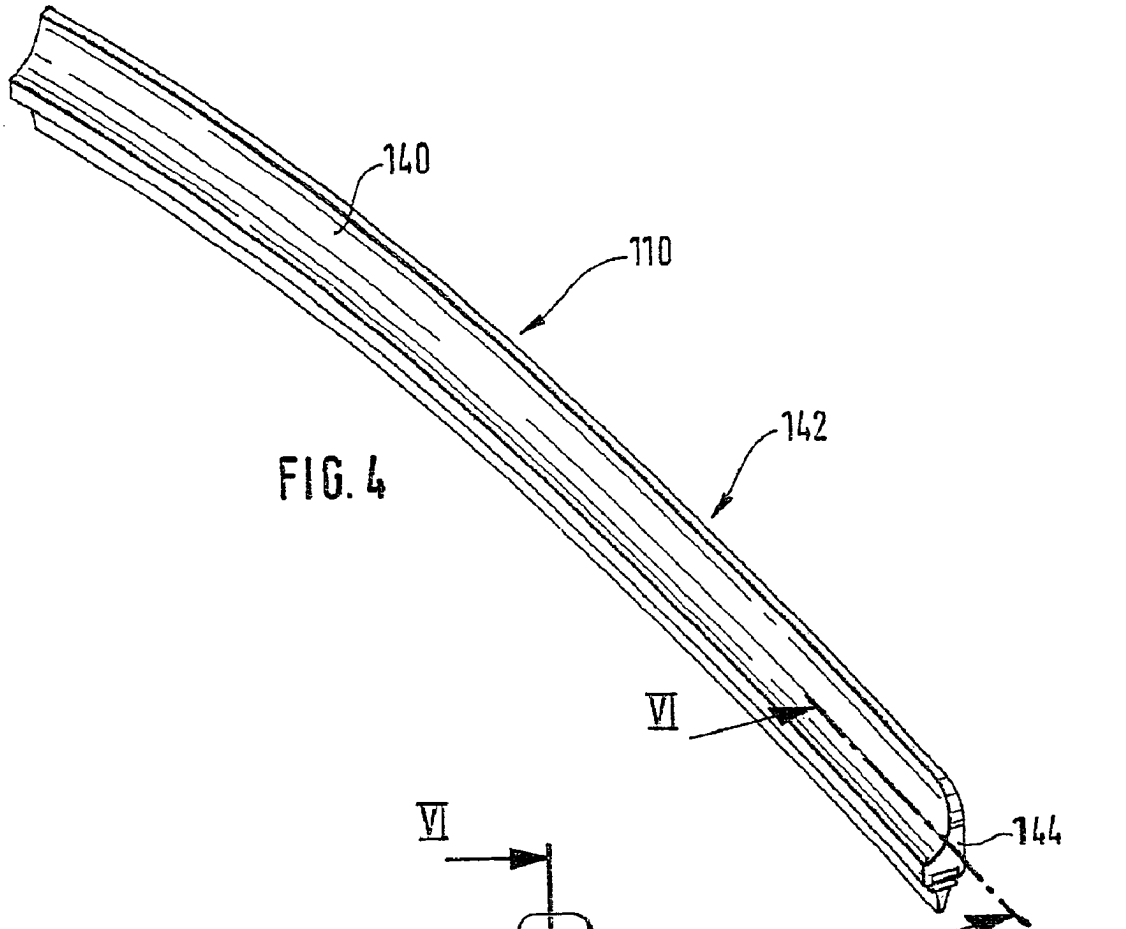
140
110
142
VI
144
VI
V

FIG. 4

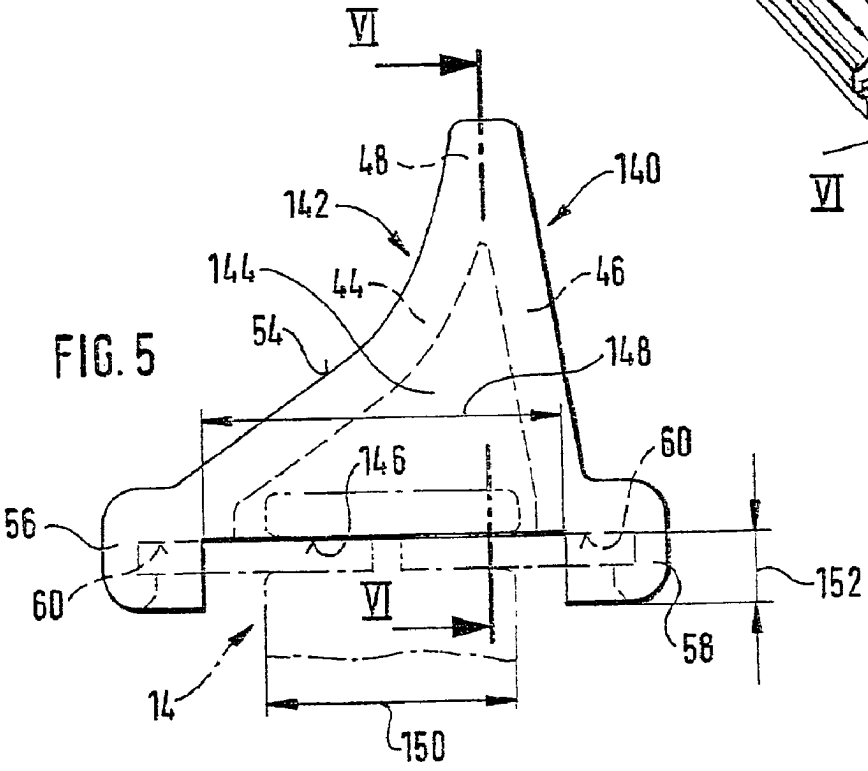
VI
48
140
142
144
44
46
54
148
60
146
56
60
VI
152
58
14
150

FIG. 5

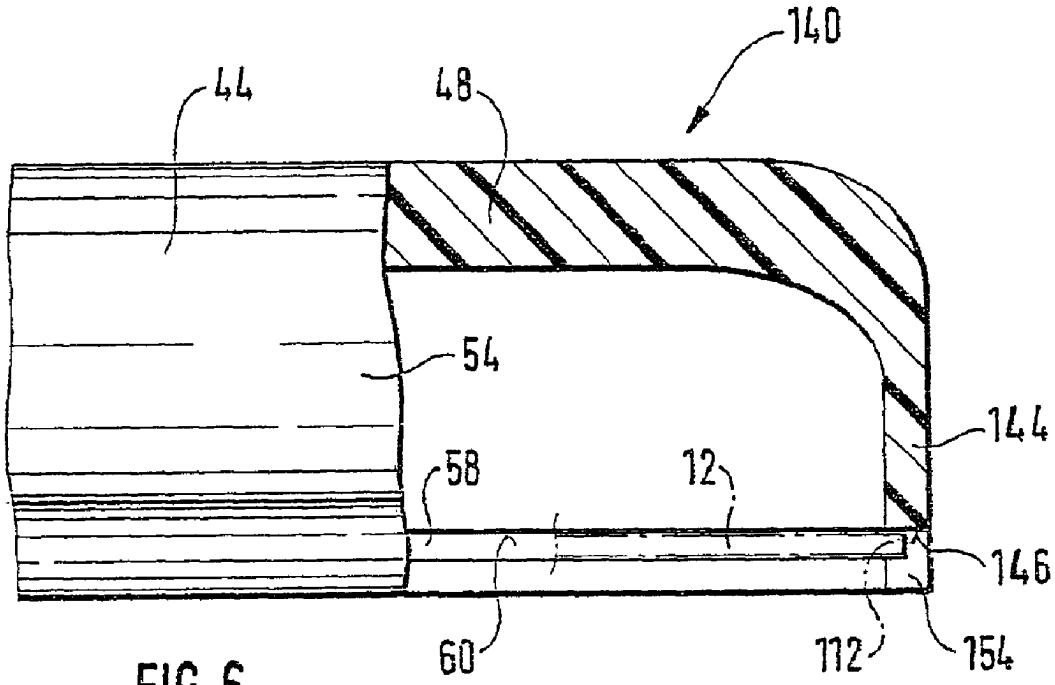
140
44
48
54
144
58
12
146
60
112
154

FIG. 6

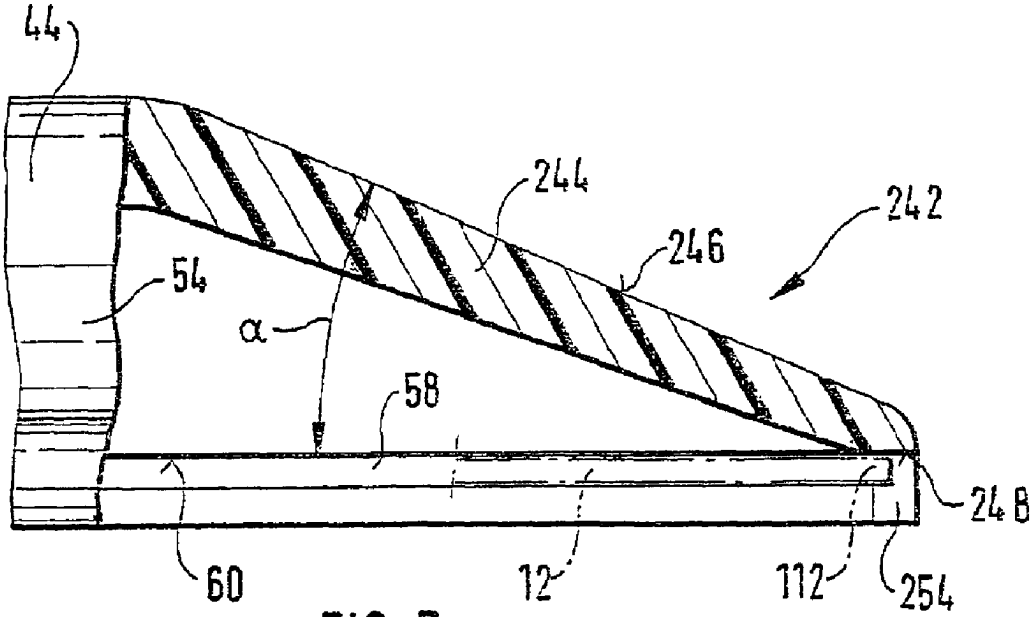
44
244
242
246
54
α
58
248
60
12
112
254

FIG. 7

WIPER BLADE FOR CLEANING SCREENS IN PARTICULAR ON MOTOR VEHICLES

BACKGROUND OF THE INVENTION

In known wiper blades, the purpose of the support element is to assure as uniform as possible a distribution of the wiper blade pressure against the window, which pressure is exerted by the wiper arm, over the entire wiping field wiped by the wiper blade. Through an appropriate curvature of the unloaded support element—i.e. when the wiper blade is not resting against the window—the ends of the wiper strip, which is placed completely against the window during operation of the wiper blade, are loaded toward the window by the support element, which is stretched in this state, even though the curvature radii of spherically curved vehicle windows change with each wiper blade position. The curvature of the wiper blade must therefore be somewhat sharper than the sharpest curvature measured within the wiping field on the window to be wiped. The support element consequently replaces the expensive support bracket structure with two spring strips disposed in the wiper strip, as is the practice in conventional wiper blades (DE-OS 15 05 357).

The invention is based on a wiper blade. In a known wiper blade of this kind (DE 197 36 368), the wiper blade is provided with a so-called wind-deflection strip so that the airflow-induced tendency of the wiper blade to lift up from the window that occurs at high driving speeds is counteracted by a force component directed toward the window. To this end, the wind-deflection strip has a front side, which is embodied as an attach surface and is acted on chiefly by the relative wind during the reciprocating wiper operation. The cross section of the wind-deflection strip is approximately the shape of a right triangle, whose one leg is oriented toward the support element and whose hypotenuse represents the attach surface. This attach surface encloses an acute angle with the plane of the reciprocating motion of the wiper blade and with the surface of the window. The triangular profile used requires a relatively large amount of material for the manufacture of the wind-deflection strip, which is reflected in the costs for the wiper blade. Moreover, the weight of the wiper blade is considerably increased in an undesirable fashion. Namely, the increased mass, which must be accelerated in the reciprocating wiper operation, requires a more powerful drive unit and a more expensive design of the reciprocating mechanism connected to this drive unit. In addition, the profile-induced rigidity of a wind-deflection strip that is shaped in this way can impair the operating behavior of the support element and/or the wiper blade.

SUMMARY OF THE INVENTION

In the wiper blade according to the invention, the weight of the wind-deflection strip is considerably reduced by the cross sectional embodiment of an angular profile. Moreover, in addition to the savings in material, there is also a reduction of the mass being moved, with the resulting advantages with regard to the design of the drive unit and the reciprocating mechanism. In addition, the rigidity of the wind deflection strip is considerably reduced and as a result, so is its influence on the bending and elastic behavior of the wiper blade support element.

If the wiper blade part of a device, which is for connecting the wiper blade to a reciprocally driven wiper arm, is supported on the upper band surface of the support element

in its middle section and an end cap is placed at both ends of the support element, then a simple installation of the wind deflection strip is produced when the strip is comprised of two sections, each of which extends between a respective end cap and the device piece.

In a modification of the invention, the profile of the cross section is the same over the entire length of the wind deflection strip. As a result, it can be manufactured in a particularly inexpensive manner using the extrusion process.

In a modification of the invention, the two legs of the wind deflection strip are connected to each other by a wall in the vicinity of the two wiper blade ends. With the use of a wind deflection strip of this kind, which is to be manufactured in an injection mold, the end caps to be placed at the ends of the support element or the wiper blade can be eliminated because this wall constitutes the end of the wind deflection strip. Furthermore, a wind deflection strip manufactured in this way can be arbitrarily shaped. It can also easily adapt to arbitrary shapes of the support element, for example when the support element has a cross sectional reduction in the longitudinal direction from the middle region toward the ends.

It is also possible to embody the tapering of the cross section of the wind deflection strip toward its ends in accordance with stylistic considerations. Thus on the one hand, it can be useful if the wall is aligned essentially perpendicular to the support element.

On the other hand, an attractively formed end of the wind deflection strip can also be achieved through a correspondingly oblique alignment of the wall in which an outside of the wall encloses an acute angle α with the support element. It goes without saying that each of the two ends of two sections belonging to a wind deflection strip can be embodied differently in accordance with the measures outlined above.

In certain applications, in order to simplify installation of the wiper blade, it can be advantageous if the wall is provided with a recess, which is open at the edge toward the window and whose width is greater than the depth of wiper strip in the vicinity of the support element and whose depth reaches to the upper band surface of the support element.

An operationally reliable support of the wind deflection strip on the wiper blade is achieved through attachment of the leg ends to the wiper blade.

Such an attachment to the wiper blade can be easily and inexpensively achieved by means of a glued attachment.

If the free leg ends of the wind deflection strip are attached, preferably glued, to the support element of the wiper blade, this assures a precise positioning of the wind deflection strip on the wiper blade.

The positioning is further improved if in the embodiment of the concept of the invention, the free leg ends of the wind deflection strip are provided, at least in sections, with claw-like projections, which encompass the mutually opposed outer edge strips of the support element.

When using wind deflection strips, which are provided with the above-mentioned end walls, it is useful if the claw-like projections extend from the leg ends into the vicinity of the wall and suitably encompass end regions of the support element.

The claw-like projections, which are used as positioning aids, offer particularly advantageous regions for the glued attachment.

For a particularly stable, operationally reliable attachment of the wind deflection strip to the support element, the claw

surface disposed on the upper band surface of the support element has a greater width than the claw surface engaging the lower band side.

The attack surface of the wind deflection strip is suitably embodied as a flute on the outer wall of the one leg.

In order to avoid an unfavorable flow progression of the relative wind sweeping past the wiper blade in the vicinity of the wiper blade ends, the end caps are provided with a flute, which extends in the projection of the flute of the wind deflection strip.

In order to counteract this disadvantage in the middle section of the wiper blade as well, the wiper blade part of the connecting device is provided with a flute, which extends in the projection of the flute of the wind deflection strip.

So that the distribution of the wiper blade pressure against the window by means of the individually designed support element is not significantly influenced by the wind deflection strip, the hardness of the material for the wind deflection strip is at most 40 percent greater than the hardness of the material for the wiper strip.

In this connection, it is particularly advantageous if the hardness of the material for the wind deflection strip is at most 20 percent greater than the hardness of the material for the wiper strip.

In many instances, it has turned out to be advantageous if the wiper strip has a Shore hardness A of between 64 and 71 and the wind deflection strip has a Shore hardness A of between 70 and 78.

Other advantageous modifications and embodiments of the invention are disclosed in the following description of exemplary embodiments shown in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective representation of a wiper blade according to the invention, with the wiper arm indicated with dot-and-dash lines,

FIG. **2** shows an enlarged cross section through the wiper blade along the line II—II in FIG. **1**,

FIG. **3** shows the cross section according to FIG. **2** through the wind deflection strip associated with the wiper blade, without the wiper strip and the support element,

FIG. **4** is a partial depiction according to FIG. **1** of a differently embodied wiper blade according to the invention,

FIG. **5** shows an enlarged view of the wiper blade according to FIG. **4**, viewed in the direction of the arrow V,

FIG. **6** shows an enlarged partial section along the line IV—IV through the end of the wind deflection strip associated with the wiper blade according to FIG. **4**, whose position is clarified in FIG. **5** by a line VI—IV, and

FIG. **7** shows a section according to FIG. **6** through another embodiment of a wind deflection strip associated with the wiper blade according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A wiper blade **10** shown in FIG. **1** has a band-like, elongated, spring-elastic support element **12** (FIGS. **1** and **2**), whose lower band side **13** oriented toward the window has an elongated, rubber-elastic wiper strip **14** attached to it so that the longitudinal axes of these two parts are parallel. On the upper band side **11** of the support element **12**, which is oriented away from the window, which support element is also referred to as a spring strip, the middle section of the support element is provided with the wiper blade part **15** of a connecting device, with the aid of which the wiper blade **10** can be detachably connected in an articulating fashion to a wiper arm **16** indicated with dot-and-dash lines in FIG. **1**. The wiper arm **16**, which is driven to reciprocate in the direction of a double arrow **18** in FIG. **1**, is loaded in the direction of an arrow **24** toward the window to be wiped, for example the windshield of a motor vehicle, whose surface is indicated with a dot-and-dash line **22** in FIG. **1**. Since the line **22** is intended to represent the sharpest curvature of the window surface, it is clear that the curvature of the wiper blade, which is not yet under tension and rests with both of its ends against the window, is sharper than the maximal window curvature (FIG. **1**). As a result of the pressure (arrow **24**), the wiper blade **10** rests with its wiper lip **26** against the window surface **22** over its entire length. This causes a tension to be built up in the spring-elastic metal support element **12**, which assures a uniform contact of the wiper strip **14** and the wiper lip **26** over its entire length against the window surface **22** and assures a uniform distribution of the pressure (arrow **24**).

The particular embodiment of the wiper blade according to the invention will now be discussed in detail.

FIG. **2** shows that the support element **12** in the exemplary embodiment has two spring strips **30**, which are disposed in a common plane approximately parallel to the window surface **22**. The two spring strips **30** protrude with their mutually opposed inner edge strips **32** into longitudinal grooves **34** of the wiper strip **14**, which are open at the edges, and protrude from these longitudinal grooves **34** with external edge strips **36**. The two spring strips **30** are secured in their longitudinal grooves **34** by the part **15** of the connecting device in the middle region of the wiper blade and by end caps **38** disposed at each end of the wiper blade. To this end, these components **15** and **38** encompass the outer edge strips **36** of the spring strips **30**. Sections **40** of a wind deflection strip **42** are respectively disposed between the part **15** and each of the two end caps **38**. The disposition of the wind deflection strip **42** and its embodiment can be inferred from FIGS. **2** and **3**. The wind deflection strip **42** comprised of an elastic material, for example a plastic, and its two sections **40** rest against the upper band side **11** of the support element **12**. Viewed in cross section, the wind deflection strip **42** has two diverging legs **44** and **46**, which are connected to each other by a common base **48**. The free ends **50** and **52** of the legs **44** and **46** are oriented toward the window **22** and are supported against the wiper blade **10** or its support element **12**. An attack surface **54**, which is fluted in the exemplary embodiment, is embodied on the outside of the one leg **44** and the relative wind chiefly flows against this attack surface **54** during operation of the wiper device. The cross sectional form of the wind deflection strip **42** and/or of its sections **40** shown in FIGS. **2** and **4** is the same over the entire length so that these sections can be inexpensively extruded. At their free leg ends **50** and **52**, the sections **40** of the wind deflection strip **42** are attached to the wiper blade and/or to its support element **12**. Suitably, the free leg ends of the wind deflection strip **42** are glued to the support element **12** of the wiper blade **10**. To that end, the free ends **50** and **52** of the legs **44** and **46** are provided with claw-like projections **56**, **58**, which suitably encompass the mutually opposed outer edge strips **36** of the support element **12**. The surfaces of the claw-like projections **56**, **58** resting against the edge strips **36** serve as gluing surfaces with which the sections **40** of the wind deflection strip **42** are glued to the support element. For a particularly stable glued attachment, the claw surfaces **60** resting against the upper band side **11** of the support element

12 (FIG. 3) have a greater width 62 than the claw surfaces 64 engaging the lower band surface 13, whose width is labeled with the reference numeral 66 in FIG. 3. It can be inferred from FIG. 1 that the fluted attack surface 54 of the sections 40 also extends on the end caps 38 and on the part 15 of the connecting device. The fluting of the end caps 38 is labeled with the reference numeral 68 in FIG. 1, while the fluting of the component 15 is provided with the reference numeral 70. The wind deflection strip 42 or its sections 40 have a cross section that remains uniform over its entire length so that it can be inexpensively extruded.

FIGS. 4 to 6 show another embodiment of the wiper blade 110 according to the invention. Since the deviations from the wiper blade 10 relate solely to the wind deflection strip, FIG. 4 shows only a section of the wiper blade 110, which reaches from one end to the part 15 of the connecting device, which part is no longer depicted. The design of the wind deflection strip 142 associated with the wiper blade 110 corresponds to the exemplary embodiment described above insofar as its attachment to the support element 12 at the outer edge strips 36 of the support element spring strips 30 is concerned, so that the attendant details need not be discussed further. Therefore, the reference numerals that have been indicated in the embodiment described above will also be used below for the embodiments of the wind deflection strip 142 that have already been explained. Viewed in cross section, the wind deflection strip 142 likewise has two legs 44, 46, which are connected to each other at a common base 48. The free ends 50 and 52 of the legs 44 and 46 are likewise provided with claw-like projections 56 and 58, which suitably encompass the outer edge strips 36 of the spring strips 30. In this exemplary embodiment as well, the two sections 140 of the wind deflection strip 142, which are produced in an injection molding die, are glued to the support element 12 of the wiper blade 10. The claw-like projections permit the wind deflection strip to be simply clipped onto the support element and thus permit a precise positioning for the gluing process. Also, the glue points reliably overlap each other. In addition, a fluted attack surface 54 is likewise embodied on the leg 44 of the wind deflection strip 142 or on its sections 140 (FIG. 5).

Diverging from the exemplary embodiment according to FIGS. 1 to 3, the two legs 44 and 46 are connected to each other by means of a wall 144 at the wiper blade ends and at the ends of the sections 140 disposed there, which wall extends from the base 48 to the claw-like projections 56, 58. The wall 144 is aligned essentially perpendicular to the support element 12 and to the claw-like projections 56, 58 encompassing it.

As FIGS. 5 and 6 show, the wall 144 is provided with a recess 146, which is open at the edge oriented toward the window and whose width 148 is greater than the width 150 of the wiper strip 14 indicated with dot-and-dash lines in FIG. 5. The depth 152 of the recess 146 reaches to the upper band surface 11 of the support element 12. This can be conceptualized on the basis of the upper claw surface 60 in FIG. 5, which when the wind deflection strip is glued to the support element, rests against the upper band side 11 of the support element 12 or against the top of its spring strips 30. It can also be inferred from FIG. 6 that the claw-like projections extend from the ends of the legs 44, 46, into the vicinity of the wall 144 and suitably encompass the end regions 112 of the support element 12, which are indicated with dot-and-dash lines. In FIG. 6, the claw-like projection of the wall 144 of the section 140 has been labeled with the reference numeral 154. The claw-like projections 56, 58 in the exemplary embodiments according to FIGS. 1 to 3 and 4 to 6 are also used to cover the sharp, free end edges of the support element 12 and are used as a reliable placement aid for the sections 40 and 140 when they are glued to the support element 12.

FIG. 7 shows an alternative disposition of the wall 144 (FIG. 6). The wall 244 situated in the end region of the wind deflection strip 242 is disposed so that its outside 246 encloses an acute angle α with the support element 12. This can be conceptualized on the basis of the claw-like projection 58, which encompasses the support element when the wind deflection strip 242 is connected to it and rests with its claw surface 60 against the upper band side 11 of the support element 12. Also in this embodiment, the wall 244 and/or its claw-like projection 254 is provided with a recess 248, which corresponds in its disposition and dimensions to the recess 146 according to the embodiment in FIGS. 4 to 6. FIG. 7 also shows that claw-like projections 254 are likewise disposed on the wall 244, which suitably encompass end regions 112 of the support element 12 that is indicated with dot-and-dash lines.

So that the desired properties of the wiper blade are not influenced to an impermissible degree by the design of the support element, the hardness of the material for the wind deflection strip 42 is at most 40% greater than the hardness of the material for the wiper strip 14. It is particularly advantageous to limit this value to 20%. In practice, it has turned out that the most favorable results with regard to the wiping quality over a broad vehicle speed range are achieved if the wiper strip 14 has a Shore hardness A of 68 and the wind deflection strip 42 has a Shore hardness A of 72.

In this connection, the thickness of the legs 44 and 46 is also of particular importance in the matching of the selected hardness of the materials for the wind deflection strip and the wiper strip.

All of the exemplary embodiments share the common trait that the wind deflection strip 42, 142, or 242 has two diverging legs 44 and 46, viewed in cross section, which are connected to each other at a common base 48 and whose free ends 50 and 52, which are oriented toward the window 22, are supported on the wiper blade 10, where the outflow surface 54 is embodied on the outside of the one leg 44.

By contrast to the exemplary embodiments described above, though, instead of the wind deflection strip 42 having two sections 40, it is also conceivable for it to be made up of one piece that extends over and covers the device part 15. Naturally, in this case, the wind deflection strip must have at least one appropriate recess, which permits the articulating connection between the wiper arm and the wiper blade.

It is also conceivable that due to particular criteria, it can be quite useful for the wiper blade according to FIG. 1 or FIG. 4 to be provided with only one section 40 or 140 of the wind deflection strip, which is fastened to the wiper blade either in its region close to the reciprocation axis or its region remote from this axis.

What is claimed is:

1. A wiper blade for cleaning windows, comprising:

a band-like, elongated, spring-elastic support element (12), wherein a lower band surface (13) of the support element oriented toward the window (22) has an elongated, rubber-elastic wiper strip (14), disposed on it so that the longitudinal axes of these two parts are parallel, wherein the wiper strip can be placed against a window, and wherein an upper band surface (11) of the support element (12; 30, 30) has a wind deflection strip (42) disposed on it, which extends in the longi-

tudinal direction of the support element (12), is provided with an attack surface (54) oriented toward the main flow of the relative wind, and is made of an elastic material, wherein the wind deflection strip (42, 142, 242) has two diverging legs (44, 46), viewed in transverse cross section, wherein the two diverging legs are connected to each other at a common base (48) and wherein free ends of the two diverging legs oriented toward the window (22) are supported on the support element of the wiper blade (10), and the attack surface (54) is embodied on the outside of the one leg (44) above the support element, and the legs (44, 46) form therebetween an angular hollow space that expands from an upper narrowest point of the base downwardly to the upper band surface of the support element (12; 30, 30) and are in contact with the upper band surface (11) of the support element said legs contacting the upper band surface at a location laterally spaced from said rubber-elastic wiper strip.

2. The wiper blade according to claim 1, wherein the profile of the cross section is the same over the entire length of the wind deflection strip (42).

3. The wiper blade according to claim 1, wherein the two legs (44, 48) of the wind deflection strip (142 or 242) are connected to each other by means of a wall (144 or 244) in the vicinity of the two wiper blade ends.

4. The wiper blade according to claim 3, wherein the wall (144) is aligned essentially perpendicular to the support element (12).

5. The wiper blade according to claim 3, wherein the outside (246) of the wall (244) encloses an acute angle (a) with the support element (12).

6. The wiper blade according to claim 1, wherein the free leg ends (50, 52) of the wind deflection strip (42, 142, or 242) are glued to the support element.

7. The wiper blade according to claim 1, wherein the free leg ends (50, 52) of the wind deflection strip (42, 142, or 242) are attached, preferably glued, to the support element (12) of the wiper blade (10).

8. The wiper blade according to claim 1, wherein the free leg ends (50, 52) of the wind deflection strip (42, 142, or 242), at least in sections, are provided with claw-like projections (56, 58), which suitably encompass the mutually opposed outer edge strips (36) of the support element (12).

9. The wiper blade according to claim 8, wherein a glued attachment is produced in the vicinity of the claw-like projections (56, 58).

10. The wiper blade according to claim 1, wherein the attack surface (54) of the wind deflection strip (42, 142, or 242) is embodied as a flute on the outer wall of the one leg (44).

11. The wiper blade according to claim 1, wherein a hardness of the material for the wind deflection strip (42) is at most 40 percent greater than the hardness of the material for the wiper strip (14).

12. The wiper blade according to claim 1, wherein a hardness of the material for the wind deflection strip (42, 142, or 242) is at most 20 percent greater than the hardness of the material for the wiper strip (14).

13. A wiper blade for cleaning windows, comprising:

a band-like, elongated, spring-elastic support element (12), wherein a lower band surface (13) oriented toward the window (22) has an elongated, rubber-elastic wiper strip (14), which can be placed against the window, disposed on it so that the longitudinal axes of these two parts are parallel and wherein an upper band surface (11) of the support element has a wind deflection strip (42) disposed on it, wherein the wind deflection strip extends in a longitudinal direction of the support element (12), is provided with an attack surface (54) oriented toward the main flow of the relative wind, and is made of an elastic material, wherein the wind deflection strip (42, 142, 242) has two diverging legs (44, 46), viewed in transverse cross section, wherein the two diverging legs are connected to each other at a common base (48) and wherein free ends of the two diverging legs oriented toward the window (22) are supported on the support element, and the attack surface (54) is embodied on the outside of the one leg (44), wherein the upper band surface (11) of the support element (12), in its middle section, includes a wiper blade part (15) for connecting the wiper blade (10) to a reciprocally driven wiper arm (16) and is supported, wherein an end cap (38) is respectively disposed at both ends of the support element (12), and wherein a section (40) of the wind deflection strip (42) is disposed between and in contact with each respective end cap (38) and the device piece (15).

14. A wiper blade for cleaning windows, comprising:

a band-like, elongated, spring-elastic support element (12), whose lower band surface (13) oriented toward the window (22) has an elongated, rubber-elastic wiper strip (14), which can be placed against the window, disposed on it so that the longitudinal axes of these two parts are parallel and whose upper band surface (11) has a wind deflection strip (42) disposed on it, which extends in the longitudinal direction of the support element (12), is provided with an attack surface (54) oriented toward the main flow of the relative wind, and is made of an elastic material, wherein the wind deflection strip (42, 142, 242) has two diverging legs (44, 46), viewed in transverse cross section, which are connected to each other at a common base (48) and whose free ends oriented toward the window (22) are supported on the support element, and the attack surface (54) is embodied on the outside of the one leg (44), wherein the two legs (44, 46) of the wind deflection strip (142 or 242) are connected to each other by means of a wall (144 or 244) in the vicinity of the two wiper blade ends, and wherein the wall (144 or 244) is provided with a recess (146 or 246) that is open at the edge oriented toward the window (22), wherein the width (148) of this recess is greater than the width (150) of the wiper strip (14) in a vicinity of the support element and its depth (152) reaches to the upper band surface (11) of the support element (12).

15. A wiper blade for cleaning windows, comprising

a band-like, elongated, spring-elastic support element (12), whose lower band surface (13) oriented toward the window (22) has an elongated, rubber-elastic wiper strip (14), which can be placed against the window, disposed on it so that the longitudinal axes of these two parts are parallel and whose upper band surface (11) has a wind deflection strip (42) disposed on it, which extends in the longitudinal direction of the support element (12), is provided with an attack surface (54) oriented toward the main flow of the relative wind, and is made of an elastic material, wherein the wind deflection strip (42, 142, 242) has two diverging legs (44, 46), viewed in transverse cross section, which are connected to each other at a common base (48) and whose free ends oriented toward the window (22) are supported on the wiper blade (10), and the attack surface (54) is embodied on the outside of the one leg (44), wherein

the free leg ends (**50**, **52**) of the wind deflection strip (**42**, **142**, or **242**), at least in sections, are provided with claw-like projections (**56**, **58**), which suitably encompass the mutually opposed outer edge strips (**36**) of the support element (**12**), and wherein the claw-like projections extend from the leg ends (**50**, **52**) into a vicinity of a wall (**154** or **254**), and suitably encompass end regions (**112**) of the support element (**12**).

16. A wiper blade for cleaning windows, comprising:

a band-like, elongated, spring-elastic support element (**12**), whose lower band surface (**13**) oriented toward the window (**22**) has an elongated, rubber-elastic wiper strip (**14**), which can be placed against the window, disposed on it so that the longitudinal axes of these two parts are parallel and whose upper band surface (**11**) has a wind deflection strip (**42**) disposed on it, which extends in the longitudinal direction of the support element (**12**), is provided with an attack surface (**54**) oriented toward the main flow of the relative wind, and is made of an elastic material, wherein the wind deflection strip (**42**, **142**, **242**) has two diverging legs (**44**, **46**), viewed in transverse cross section, which are connected to each other at a common base (**48**) and whose free ends oriented toward the window (**22**) are supported on the support element, and the attack surface (**54**) is embodied on the outside of the one leg (**44**), wherein the free leg ends (**50**, **52**) of the wind deflection strip (**42**, **142**, or **242**), at least in sections, are provided with claw-like projections (**56**, **58**), which suitably encompass the mutually opposed outer edge strips (**36**) of the support element (**12**), and wherein the claw surfaces (**60**) resting against the upper band surface (**11**) of the support element (**12**) have a greater width (**62**) than the claw surfaces (**64**) engaging the lower band side (**13**).

17. A wiper blade for cleaning windows, comprising:

a band-like, elongated, spring-elastic support element (**12**), whose lower band surface (**13**) oriented toward the window (**22**) has an elongated, rubber-elastic wiper strip (**14**), which can be placed against the window, disposed on it so that the longitudinal axes of these two parts are parallel and whose upper band surface (**11**) has a wind deflection strip (**42**) disposed on it, which extends in the longitudinal direction of the support element (**12**), is provided with an attack surface (**54**) oriented toward the main flow of the relative wind, and is made of an elastic material, wherein the wind deflection strip (**42**, **142**, **242**) has two diverging legs (**44**, **46**), viewed in transverse cross section, which are connected to each other at a common base (**48**) and whose free ends oriented toward the window (**22**) are supported on the support element, and the attack surface (**54**) is embodied on the outside of the one leg (**44**), wherein the upper band surface (**11**) of the support element (**12**), in its middle section, the wiper blade part (**15**) of a device, which is for connecting the wiper blade (**10**) to a reciprocally driven wiper arm (**16**), is supported, wherein an end cap (**38**) is respectively disposed at both ends of the support element (**12**), wherein a section (**40**) of the wind deflection strip (**42**) is disposed between each respective end cap (**38**) and the device piece (**15**), and wherein the end caps (**38**) are provided with a flute (**68**), which extends in a projection of the flute of the attack surface (**54**) of the wind deflection strip.

18. A wiper blade for cleaning windows, comprising:

a band-like, elongated, spring-elastic support element (**12**), whose lower band surface (**13**) oriented toward the window (**22**) has an elongated, rubber-elastic wiper strip (**14**), which can be placed against the window, disposed on it so that the longitudinal axes of these two parts are parallel and whose upper band surface (**11**) has a wind deflection strip (**42**) disposed on it, which extends in the longitudinal direction of the support element (**12**), is provided with an attack surface (**54**) oriented toward the main flow of the relative wind, and is made of an elastic material, wherein the wind deflection strip (**42**, **142**, **242**) has two diverging legs (**44**, **46**), viewed in transverse cross section, which are connected to each other at a common base (**48**) and whose free ends oriented toward the window (**22**) are supported on the support element, and the attack surface (**54**) is embodied on the outside of the one leg (**44**), wherein the upper band surface (**11**) of the support element (**12**), in its middle section, the wiper blade part (**15**) of a device, which is for connecting the wiper blade (**10**) to a reciprocally driven wiper arm (**16**), is supported, wherein an end cap (**38**) is respectively disposed at both ends of the support element (**12**), and wherein a section (**40**) of the wind deflection strip (**42**) is disposed between each respective end cap (**38**) and the device piece (**15**), and the wiper blade part (**15**) of the connecting device is provided with a flute (**70**), which extends in a projection of the flute of the attack surface (**54**) of the wind deflection strip (**42**).

19. A wiper blade for cleaning windows, comprising:

a band-like, elongated, spring-elastic support element (**12**), whose lower band surface (**13**) oriented toward the window (**22**) has an elongated, rubber-elastic wiper strip (**14**), which can be placed against the window, disposed on it so that the longitudinal axes of these two parts are parallel and whose upper band surface (**11**) has a wind deflection strip (**42**) disposed on it, which extends in the longitudinal direction of the support element (**12**), is provided with an attack surface (**54**) oriented toward the main flow of the relative wind, and is made of an elastic material, wherein the wind deflection strip (**42**, **142**, **242**) has two diverging legs (**44**, **46**), viewed in transverse cross section, which are connected to each other at a common base (**48**) and whose free ends oriented toward the window (**22**) are supported on the support element, and the attack surface (**54**) is embodied on the outside of the one leg (**44**), and wherein the wiper strip (**14**) has a Shore hardness A of between 64 and 71, in particular 68, and the wind deflection strip (**42**) has a Shore hardness A greater than the wiper strip and is of between 70 and 78, in particular 72.

* * * * *

EXHIBIT H

US006292974B1

(12) **United States Patent**
Merkel et al.

(10) **Patent No.: US 6,292,974 B1**
(45) **Date of Patent: Sep. 25, 2001**

(54) **GLASS WIPER BLADE FOR MOTOR VEHICLES**

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PCT Pub. Date: **Mar. 4, 1999**

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(52) **U.S. Cl.** **15/250.201**; 15/250.43
(58) **Field of Search** 15/250.201, 250.43, 15/250.44, 250.361, 250.48, 250.451, 250.32

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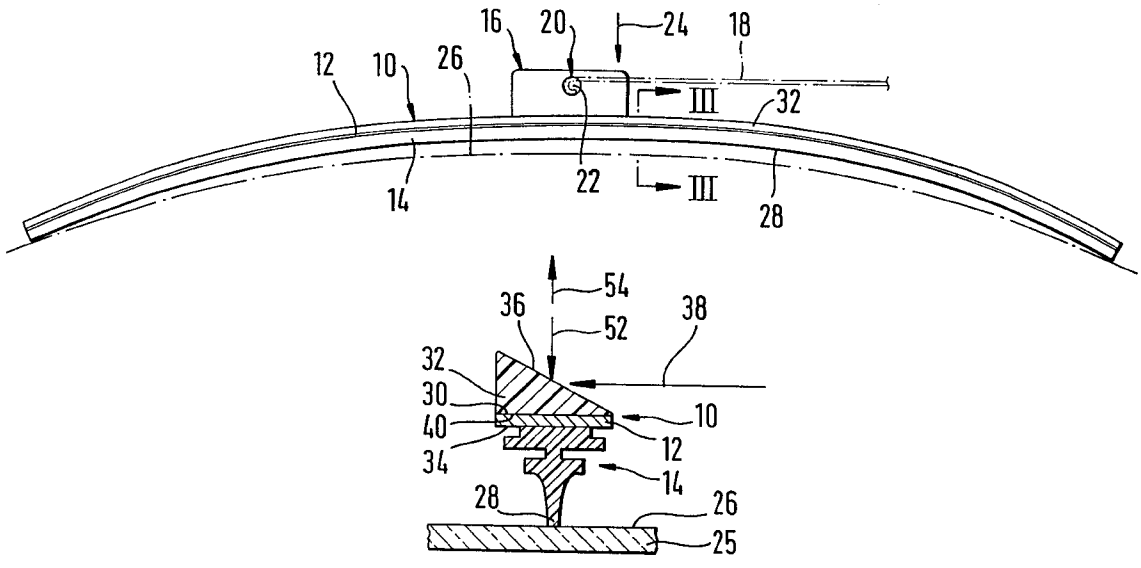
(57) **ABSTRACT**

A wiper blade **(10)** is proposed that serves to clean windows of motor vehicles. The wiper blade has an elongated, rubber-elastic wiper strip **(14)** which can be placed against the window to be wiped and is disposed substantially longitudinally axially parallel to one face, that is, the face oriented toward the window, of a striplike, spring-elastic support element **(12)**, which is connected to a wiper arm **(18)** that is driven crosswise to the length of the wiper blade and can be urged toward the window. Even at high vehicle speeds, a requisite wiper blade contact pressure for attaining a swept field clean enough to meet legal requirements is achieved if the wiper blade **(10)** is provided with a leading-edge face **(36** or **60)**, which extends longitudinally of the wiper blade and substantially parallel to the window and faces into the wind (arrow **38)**, and which crosswise to its length forms an acute angle with the window.

8 Claims, 1 Drawing Sheet



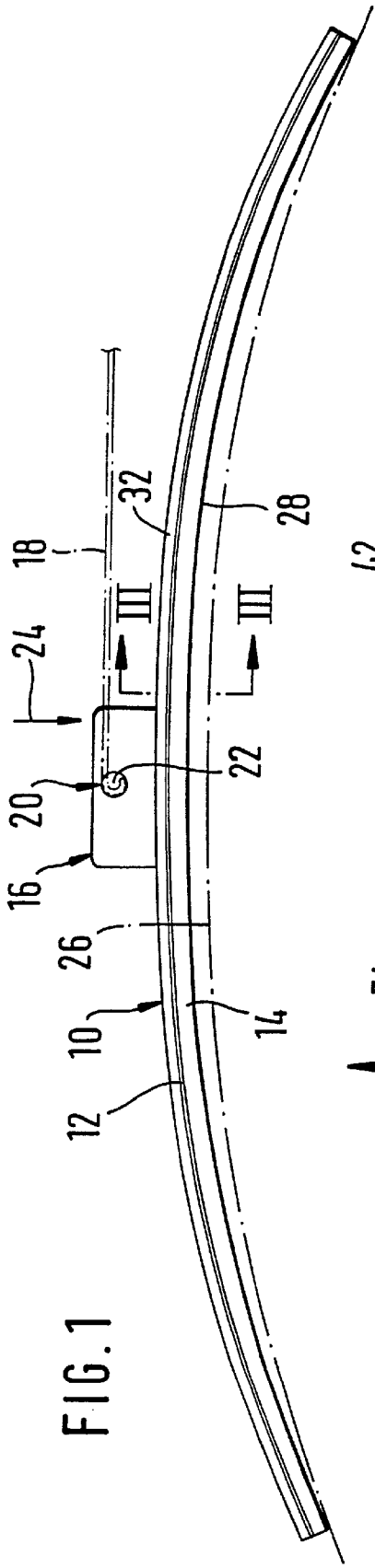


FIG. 1

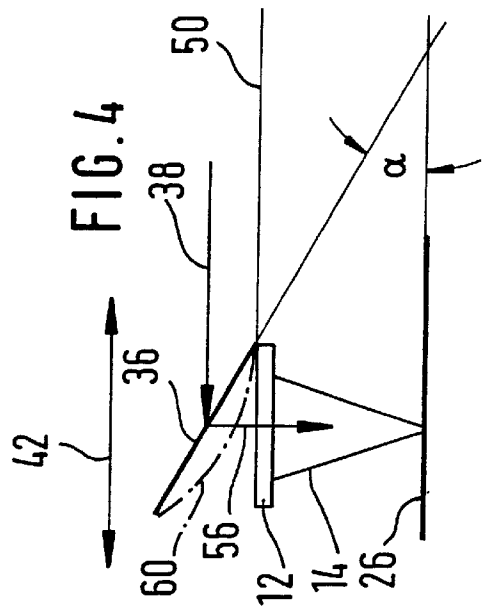


FIG. 4

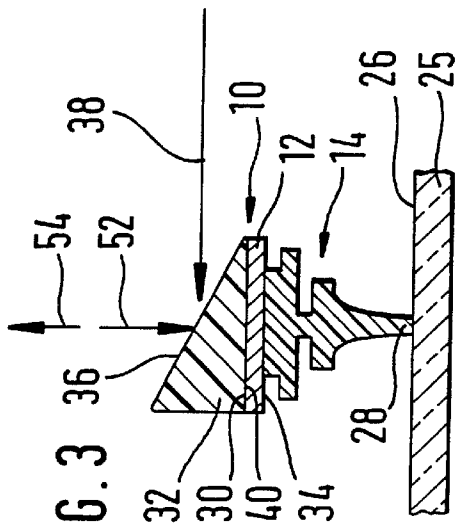


FIG. 3

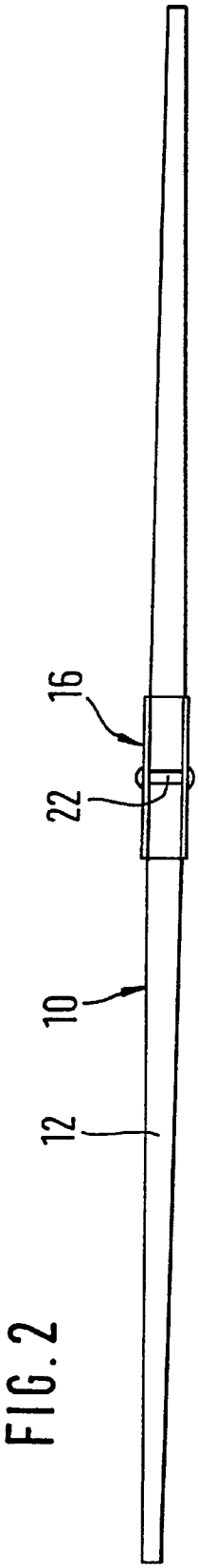


FIG. 2

GLASS WIPER BLADE FOR MOTOR VEHICLES

BACKGROUND OF THE INVENTION

The present invention relates to a wiper blade for windows of motor vehicles.

In wiper blades the support element is meant to assure the evenest possible distribution of the wiper blade contact pressure on the windows, over the entire swept field swept by the wiper blade. By means of a suitable curvature of the unstressed support element—that is, when the wiper blade is not applied to the wiper blade—the ends of the wiper strip, which in wiper blade operation is pressed entirely against the window, are urged toward the window by the then-stressed support element, even if the radii of curvature of spherically curved vehicle windows differ in every position of the wiper blade. The curvature of the wiper blade must accordingly be somewhat greater than the greatest curvature measured in the swept field of the window to be wiped. The support element thus replaces the complicated support bracket construction, having two spring rails disposed in the wiper strip, of the kind employed in conventional wiper blades.

The invention takes as its point of departure a wiper blade of this type. In a known wiper blade of this type (German Patent DE-PS 12 47 161), the wiper blade, or its support element, which for reasons of distributing the contact pressure protrudes far past the wiper strip in the middle region of the wiper blade, can on the one hand be engaged from below, on the front side facing into the wind, with an attendant buildup of overpressure, by this overpressure. On the other hand, on the back side facing away from the wind, because of the structural form noted above, a considerable negative pressure builds up. Although the wiper blade, which during operation usually executes a pendulum motion, constantly changes its position relative to the oncoming relative wind, even then one of its long sides is always more or less greatly exposed to the wind and is therefore called the front side, while its other long side is accordingly also thought of as the back side. At relatively high vehicle speeds, given the cooperation of these two aforementioned pressures, both of which are oriented counter to the wiper blade contact pressure, this contact pressure is reduced at least enough that proper wiping is no longer possible. Increasing the wiper blade contact pressure against the window at high vehicle speeds could admittedly reduce the severity of this problem, but at lower vehicle speeds, when the liftoff tendency is less, the friction between the wiper blade and the window increases; this leads to undesirable noise buildup and to excessively high stress on the drive components and on the rubber of the wiper.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a wiper blade which avoids the disadvantages of the prior art.

In keeping with these objects, one feature of present invention, resides, briefly stated, in a wiper blade provided with a leading-edge face which extends longitudinally over the wiper blade and substantially parallel to the window and faces into the wind, and which crosswise to its length forms an acute angle with the window.

In the wiper blade of the invention, via the leading-edge face that faces into the wind, a force component aimed at the window is built up, which counteracts the liftoff tendency of the two pressures and thus assures excellent cleaning quality,

at least in the region of the swept field swept by the wiper blade, that is, the region that is important to the vehicle's driver. Depending on the size of the leading-edge face and/or on the size of the approach angle α, this auxiliary contact pressure can be adapted to the variable demands that depend on the type of vehicle. It is also advantageous in the arrangement of the invention that as a function of the vehicle speed, the contact pressure rises or falls with this speed. Thus a suitably "high auxiliary contact pressure" is opposed only to the liftoff tendency that occurs at high speed.

A compact wiper strip is obtained if the leading-edge face is disposed on the face of the support element facing away from the window. The auxiliary contact pressure is then distributed not in point form but areally, over the entire length of the wiper blade.

The embodiment of a leading-edge face can advantageously by attained in that it is embodied on a separate, elongated component that is solidly joined to the support element.

A simple structure of such a separate component is obtained in that, seen in cross section, it has at least approximately the shape of a triangle, one side of which contacts the face of the support element facing away from the window, and also that the leading-edge face is embodied on another side of the triangle. In certain cases, it can be advantageous to equip the leading-edge face at least partially with a hollow curvature facing into the wind.

Securing the component to the one side of the support element is achieved economically by a glued connection. So that the distribution of the contact pressure effected by the support element will not be impaired, the component is made from a rubber-elastic material whose hardness is no greater, and is preferably less, than the hardness of the rubber-elastic wiper strip. Advantages in terms of production are attained if the component is made from a suitable plastic.

The length, and the width and height projected in the operating direction of the wiper blade, of the leading-edge face is designed to suit the requirements. In certain cases it is expedient if the leading-edge face extends at least nearly over the entire length of the wiper blade.

Further advantageous refinements and features of the invention are recited in the ensuing description of an exemplary embodiment shown in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. **1** shows a side view of a wiper blade of the invention;

FIG. **2** shows a plan view on the wiper blade of FIG. **1**;

FIG. **3** shows a section through the wiper blade, taken along the line III—III in FIG. **1** and shown on a larger scale in schematic form; and

FIG. **4** shows a basic illustration of the wiper blade of FIG. **3**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A wiper blade **10** shown in FIGS. **1** and **2** has a single- or multi-part, elongated, spring-elastic support element **12**, to whose underside an elongated, rubber-elastic wiper strip **15** is secured longitudinally axially parallel to it. A connection device **16** is disposed on the top side of the support element, and with its aid the wiper blade **10** can be detachably

connected to a driven wiper arm **18**. A hook acting as a counterpart connection means is formed onto the free end **20** of the wiper arm **18** and grasps a pivot pin **22** that belongs to the connection device **22** of the wiper blade. The securing between the wiper arm **18** and the wiper blade **10** is taken on by securing means not shown in further detail but known per se and embodied as adapters. The wiper arm **18** and thus also the hook on the end **20** of the arm is urged in the direction of the arrow **24** toward the window to be wiped, whose surface to be wiped is suggested in FIG. **1** by a dot-dash line **26**. Since the dot-dash line **26** is meant to represent the greatest curvature of the window surfaces, it is quite apparent that the curvature of the wiper blade **10**, which rests with its two ends on the window, is greater than the maximum curvature of the window. Under the contact pressure (arrow **24**), the wiper blade presses with its wiper lip **28** over its entire length against the window surface **26**. This causes a tension to build up in the bandlike, spring-elastic support element **12**, and this tension assures a proper contact of the wiper strip **14** or wiper lip **28**, over their entire length, with the motor vehicle window.

The particular design of the wiper blade **10** will be described in further detail, especially in terms of FIGS. **3** and **4**. On the upper face **30** of the bandlike support element **12**, facing away from the windshield **25**, a single- or multiple-part component **32** extending longitudinally of the wiper blade **10** is secured; it is made from a rubber-elastic material, preferably a plastic, whose hardness is less than the hardness of the rubber-elastic wiper strip **14**. This wiper strip **14** is disposed on the lower face **34**, toward the window **25**, of the support element **12**. As FIG. **1** shows, the component **32** extends over the entire length of the wiper blade **10**. It has a cross section in the shape of a triangle or wedge (FIG. **3**). In the exemplary embodiment, to that end, the shape of a non-isosceles triangle has been selected. The longest side **36** of this triangle forms a leading-edge face for the relative wind created by the motor vehicle, which is symbolized by the arrow **38** in FIG. **3**. A second, shorter side **40** of the triangular shape faces toward the upper face **30** of the support element **12**. The two faces, facing one another, of the support element **12** and **40** of the component **32** are joined together by gluing.

To explain the mode of operation of the wiper blade of the invention, see FIG. **4**, in which all the necessary parts of the wiper blade are shown in basic form. During operation of the wiper blade, whose operating motion is represented by the double arrow **42** when the wiper blade is displaced with its wiper strip **14** over the surface **26** of the window, the support element **12** is located in a plane that extends substantially parallel to the surface **26** of the window. The wiper blade **10** then experiences a contact pressure **52** (FIG. **3**) that is countered during wiper blade operation, especially at high vehicle speeds, by a liftoff tendency acting in the direction of the arrow **54** in FIG. **4**. Since the leading-edge face **36** of the component **30** facing into the wind **38**, and forms an acute angle a with the surface **26** of window **25**, the pressure of the relative wind **38** generates a force component that is represented in FIG. **4** by the arrow **56**. This force component **56** acts counter to the liftoff tendency (arrow **54**) in FIG. **3** and thus keeps the contact pressure (arrow **52**) within the legally prescribed range. In a departure from the exactly triangular cross-sectional shape shown in FIG. **3** for the component **12**, this component can also be embodied such that its side facing into the wind **38** is provided with a hollow curvature **60**, which is represented in FIG. **4** by a dot-dash line. But even with the provision of a hollow curvature on the side toward the wind **38**, the component **30** maintains its basically triangular cross-sectional shape and thus also the possibility of the development of a force component (arrow **56** in FIG. **4**) from the contact pressure with which the wind (arrow **38**) meets the curved leading-edge face **60**.

What is claimed is:

1. A wiper blade for windows of motor vehicles, comprising a curved, band-shaped, spring-elastic support element which distributes a pressure applied by a wiper arm and has a concave and a convex surface which defines corresponding planes; an elongated rubber-elastic wiper strip placeable on a window to be wiped and mounted to said concave surface of said support element which faces the window, substantially longitudinally parallel to said concave surface; a connection device provided for a wiper arm and arranged directly on a convex side of said support element; and a component which is separate from said wiper strip and is mounted directly to the convex surface of said support element so as to form a leading-edge face extending in a longitudinal direction of the support element and forming, as seen crosswise to its longitudinal extension, an acute angle with a plane which extends parallel to a plane formed by said convex surface.

2. A wiper blade as defined in claim **1**, wherein said leading-edge face is disposed on a face of said support element which faces away from the window.

3. A wiper blade as defined in claim **1**, wherein said leading-edge face is formed as a separate elongated component which is solidly joined to said support element.

4. A wiper device as defined in claim **3**, wherein said component, seen in a transverse cross-section, has at least approximately a shape of a triangle with one side contacting a face of said support element facing away from the window, and said leading-edge face being formed on another side of said triangle.

5. A wiper device as defined in claim **3**, wherein said component is glued to the one side of said support element.

6. A wiper device as defined in claim **3**, wherein said component is composed of a rubber-elastic material with a hardness which is no greater than a hardness of said rubber-elastic wiper strip.

7. A wiper device as defined in claim **3**, wherein said component is composed of plastic.

8. A wiper blade as defined in claim **1**, wherein said leading-edge face extends at least nearly over an entire length of the wiper blade.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

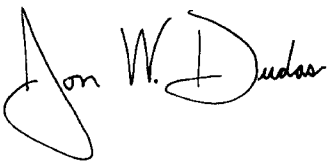
PATENT NO. : 6,292,974 B1
APPLICATION NO. : 09/284398
DATED : September 25, 2001
INVENTOR(S) : W. Merkel et al.

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

Title Pg., Item (75), after "Buehlertal" delete ",all of (DE)" and substitute --; Friedrich Don, Waiblingen, all of (DE)--

Signed and Sealed this

Second Day of September, 2008



JON W. DUDAS
Director of the United States Patent and Trademark Office