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Unilin Beheer B.V. and Flooring Industries, Ltd. Sarl

UNITED STATES DISTRICT COURT

CENTRAL DISTRICT OF CALIFORNIA

UNILIN BEHEER B.V., and FLOORING INDUSTRIES, LTD. SARL,

Plaintiffs,

v.

TROPICAL FLOORING, a business entity form unknown; MAXIMUS FLOORING, a business entity form unknown; FANTASTIC FLOORING, a business entity form unknown; FLOORINDO, INC., a California Corporation; GUNTAR SALIM, an individual; TEGUH SALIM, an individual; TOUPAN SALIM, and individual; BOBBY LIN aka BOBBY LIM, an individual; KC INDUSTRIES CO. doing business as K & C FLOORING, a business entity form unknown; CHRISTINA & SON, INC, a California corporation; YUN FANG ZHANG aka CHRISTINA ZHANG, an individual; HENGXIANG FLOORING, INC., a California corporation; POPULAR FLOORING, a business entity form unknown; and DOES 1 to 25,

Defendants.

CASE NO.: 2:14-CV-02209 BRO (SSX)

FIRST AMENDED COMPLAINT

Plaintiffs allege the following:

NATURE OF THE ACTION

1. This is an action for patent infringement arising under the Patent Laws of the United States, 35 U.S.C. §§ 1, et seq.

2. Pursuant to Section 337 of the Tariff Act of 1930, Plaintiffs previously brought a Complaint with the United States International Trade Commission ("ITC") after discovering increasing imports of laminated floor panel products which infringed the patents in suit.

3. In January 2007, the ITC issued a decision declaring the Plaintiffs' patents to be valid and infringed. The ITC then issued a General Exclusion Order under 19 U.S.C. Section 1337(d)(2). Attached hereto as **Exhibit A** is a true and correct copy of the ITC's Notice of Final Determination; Issuance of General Exclusion Order and Cease and Desist Orders; Termination of Investigation.

4. After appeal, in July 2008, the Federal Circuit affirmed the decision of the ITC. *See Yingbin-Nature (Guandong) Wood Industry Co. v. International Trade Commission*, 535 F.3d 1322 (Fed. Cir. 2008), attached hereto as **Exhibit B**. Upon information and belief, all Defendants herein either had actual or constructive notice of the ITC's General Exclusion Order and/or the Federal Circuit's 2008 ruling, attached hereto as **Exhibits A and B**.

THE PARTIES

5. Plaintiff Unilin Beheer B.V. is a company organized under the laws of the Netherlands with its principal place of business at 1 Beneluxstraat, 5061KD Oisterwijk, The Netherlands.

6. Plaintiff Flooring Industries, Ltd. Sarl is the exclusive licensee to the patents-at-issue in this matter and has its principal place of business at 10b Rue des Mérovingiens, Zone Industrielle Bourmicht, Bertrange 8070, Luxembourg.

7. Upon information and belief, Defendant Floorindo, Inc. is a California Corporation with its principal place of business at 2400 Chico Avenue, South El Monte, CA 91733. Floorindo, Inc. conducts business under the fictitious names Tropical Flooring, Fantastic Flooring, and Popular Flooring, as well as Maximus Flooring. Floorindo, Inc. is in the business of importing, offering for sale, and selling mechanically locking laminated flooring products.

8. Upon information and belief, Defendant Tropical Flooring is a business entity form unknown with its principal place of business at 2400 Chico Ave., South El Monte, CA 91733. Tropical Flooring also does business at 9617 Valley Blvd., El Monte, CA 91731. Tropical Flooring is in the business of importing, offering for sale, and selling mechanically locking laminated flooring products.

9. Upon information and belief, Defendant Maximus Flooring is a business entity form unknown with its mailing address at a mail drop location located at 1613 Chelsea Rd #348, San Marino, California. Defendants use this fictitious business name and upon information and belief, Defendants actually operate Maximus Flooring at 2400 Chico Avenue, South El Monte, CA 91733 and 9617 Valley Blvd, El Monte, CA 91731. Maximus Flooring is in the business of importing, offering for sale, and selling mechanically locking laminated flooring products.

10. Upon information and belief, Defendant Fantastic Flooring is a business entity form unknown with its principal place of business at 9617 Valley Blvd., El Monte, CA 91731. Fantastic Flooring is also believed to do business at 2400 Chico Avenue, South El Monte, CA 91733. Fantastic Flooring is in the business of importing, offering for sale, and selling mechanically locking laminated flooring products.

11. Plaintiffs are informed and believe and thereon allege that Defendant Guntar Salim is an individual who resides in Los Angeles County, California.

12. Plaintiffs are informed and believe and thereon allege that Defendant Teguh Salim is an individual who resides in Los Angeles County, California.

13. Plaintiffs are informed and believe and thereon allege that Defendant Toupan Salim is an individual who resides in Los Angeles County, California.

14. Plaintiffs are informed and believe and thereon allege that Defendant Bobby Lin aka Bobby Lim is an individual who resides in Los Angeles County, California. Defendant Bobby Lin is the President of Defendant Floorindo, Inc.

15. Upon information and belief, Defendant KC Industries Co. doing business as K & C Flooring is a business entity form unknown but believed to be a fictitious business name used by Defendants with its principal place of business at 4359 Temple City Blvd., Temple City, CA 91780. K&C Flooring is in the business of importing, offering for sale, and selling mechanically locking laminated flooring products.

16. Upon information and belief, Defendant Christina & Son, Inc. is a California corporation with its principal place of business at 4359 Temple City Blvd., Temple City, CA 91780. Christina & Son, Inc. conducts business under the fictitious name KC Industries Co. Christina & Son, Inc. is in the business of importing, offering for sale, and selling mechanically locking laminated flooring products.

17. Upon information and belief, Defendant KC Industries Co. doing business as K & C Flooring is a business entity form unknown with its principal place of business at 4359 Temple City Blvd., Temple City, CA 91780. KC Industries Co. is in the business of importing, offering for sale, and selling mechanically locking laminated flooring products.

18. Plaintiffs are informed and believe and thereon allege that Defendant Yun Fang Zhang aka Christina Zhang is an individual who resides in Los Angeles County, California. Defendant Zhang is the President of Christina & Son, Inc.

19. Upon information and belief, Defendant Hengxiang Flooring, Inc. is a California Corporation with its principal place of business at 2400 Chico Avenue,

South El Monte, CA 91733. Hengxiang Flooring is in the business of importing, offering for sale, and selling mechanically locking laminated flooring products.

20. Upon information and belief, Defendant Popular Flooring is a business entity form unknown with its principal place of business at 2400 Chico Avenue, South El Monte, CA 91733. Popular Flooring is in the business of importing, offering for sale, and selling mechanically locking laminated flooring products.

21. Plaintiffs are informed and believe that Defendants Guntar Salim, Teguh Salim, Toupan Salim, Bobby Lin, and Yun Fang Zhang in conjunction with DOES 1-25, jointly own, manage, and/or control Tropical Flooring, Maximus Flooring, Fantastic Flooring, Floorindo, Inc., KC Industries Co. dba K & C Flooring, Christina & Son, Inc., Hengxiang Flooring, Inc., and Popular Flooring. Defendants Guntar Salim, Teguh Salim, Toupan Salim, and DOES 1-25 import, distribute and sell products that infringe Plaintiffs' patents through their alter-egos such as entities Tropical Flooring, Maximus Flooring, Fantastic Flooring, Floorindo, Inc., KC Industries Co. dba K & C Flooring, Christina & Son, Inc., Hengxiang Flooring, Inc., Popular Flooring, and DOES 1-25. Defendants continue to sell such products through different fictitious entities to mask their respective involvement in the improper importation, distribution and sale of products that infringe Plaintiffs' patents.

22. Plaintiffs are informed and believe and thereon allege that some of Defendants and DOES 1 through 25, inclusive, are importers, vendors and distributors of products that infringe Plaintiffs' patents as described below. The true names, whether corporate, individual or otherwise, and capacities of defendants sued herein as DOES 1 through 25 are presently unknown to Plaintiffs at this time, and therefore, Plaintiffs sue said defendants by such fictitious names. Plaintiffs will seek leave to amend this complaint to allege their true names and capacities when the same have been ascertained. Plaintiffs are informed and believe, and based thereon allege, that each of defendants designated as a DOE is

responsible in some manner for the events alleged herein and the damages caused thereby. The named Defendants, and DOES 1-25 may be collectively referred to as "Defendants."

23. Plaintiffs are informed and believe and thereupon allege that at all times relevant hereto each of Defendants acted in concert with each other, was the agent, affiliate, officer, director, manager, principal, alter-ego, co-conspirator, aider and abettor, and/or employee of the remaining defendants and was at all times acting within the scope of such agency, affiliation, alter-ego relationship and/or employment; and actively participated in or subsequently ratified and adopted, or both, each and all of the acts or conducts alleged, with full knowledge of all the facts and circumstances, including without limitation to full knowledge of each and every wrongful conducts and Plaintiffs' damages caused therefrom.

JURISDICTION AND VENUE

24. This is an action for patent infringement arising under the Patent Laws of the United States, Title 35 of the United States Code.

25. This Court has subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338.

26. Upon information and belief, Defendants regularly conduct business in this judicial district and have committed acts of patent infringement in this judicial district including, inter alia, importing, selling and offering to sell infringing products and services in this judicial district.

27. Upon information and belief, Defendants have ongoing and systematic contacts with this judicial district and the United States. In particular, Defendants' principal places of business are located in this judicial district.

28. Venue is proper in this judicial district under 28 U.S.C. §§ 139l(c) and 1400(b).

JOINDER

29. Defendants are properly joined under 35 U.S.C. §299(a)(1) because a right to relief is asserted against the parties jointly, severally and in the alternative with respect to the same transactions, occurrences, or series of transactions or occurrences relating to the using, importing into the United States, offering for sale, and/or selling the same accused products. Specifically, as alleged in detail below, Defendants are alleged to infringe Unilin's patents with respect to the same mechanically locking laminate flooring system.

30. Defendants are properly joined under 35 U.S.C. §299(a)(2). Questions of fact will arise that are common to all defendants, including for example, whether Defendants' products have features that meet the features of one or more claims of Unilin's Patents, and what reasonable royalty will be adequate to compensate the owner of the Asserted Patents for its infringement.

31. Defendants use, sell, offer for sale and/or import products that infringe on Unilin's patents.

32. At least one right to relief is asserted against these parties jointly, severally, or in the alternative with respect to or arising out of the same transaction, occurrence, or series of transactions or occurrences relating to the using, importing into the United States, offering for sale, and/or selling of the same accused product and/or process.

FIRST CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. 6,874,292

33. The allegations set forth in the foregoing paragraphs are incorporated into this First Claim for Relief.

34. On April 5, 2005, U.S. Patent No. 6,874,292 ("the '292 patent"), entitled "Floor Panel With Edge Connectors" was duly and legally issued by the United States Patent and Trademark Office. A true and correct copy of the '292 Patent is attached as **Exhibit C** to this First Amended Complaint.

35. Plaintiffs are the assignee and owner of the right, title and interest in and to the '292 Patent, including the right to assert all causes of action arising under said patent and the right to any remedies for infringement of it.

36. In violation of 35 U.S.C. § 271, Defendants have directly infringed and continue to directly infringe, literally and/or under the doctrine of equivalents, the '292 Patent by importing, using, selling and/or offering for sale in the United States, including in this Judicial District, mechanically locking laminated floor panel products that embody or infringe the '292 Patent ("the '292 Accused Products and Services"), without the authority of Plaintiffs.

37. Plaintiffs provided actual notice to Defendant Tropical Flooring of its infringement of the '292 Patent in multiple letters, the earliest dated September 2008.

38. Plaintiffs provided actual notice to Defendant Maximus Flooring of its infringement of the '292 Patent in multiple letters, the earliest dated February 2012.

39. Plaintiffs provided actual notice to Defendant KC Industries Co. of its infringement of the '292 Patent in multiple letters, the earliest dated November 2011.

40. All Defendants (other than Teguh Salim and Toupan Salim) have had actual knowledge of the '292 Patent and their infringement of that patent since at least the date that the letters were received by Defendants and/or their related entities.

41. Upon information and belief, all Defendants (other than Teguh Salim and Toupan Salim) have committed and continue to commit acts of contributory infringement of the '292 patent under 35 U.S.C. § 27l(c) by selling, offering to sell, and/or importing products including the '292 Accused Products and Services for the '292 Patent, knowingly or willfully blind to the fact that these products and service constitute a material part of the invention, were especially made or

especially adapted for use in an infringement of the '292 Patent, and have no substantial non-infringing uses.

42. Upon information and belief, since at least the date they received the notice letter from Plaintiffs, notifying Defendants that their products infringed the '292 Patent, all Defendants (other than Teguh Salim and Toupan Salim) have induced and continue to induce others to infringe the '292 Patent under 35 U.S.C. § 271(b) by, among other things, and with specific intent, actively and knowingly aiding and abetting others to infringe, including, but not limited to, Defendants' customers whose use of the '292 Accused Services and Products constitutes direct infringement of the '292 Patent. In particular, Defendants acted with specific intent to make others, such as its customers, infringe by advertising and selling the products and by providing written instructions instructing customers on how to assemble and use the products. On information and belief, Defendants engaged in such actions with specific intent to cause infringement or with willful blindness to the resulting infringement because Defendants have had actual knowledge of the '292 Patent and that its acts were inducing its customers to infringe the '292 Patent.

43. Plaintiffs have been harmed by Defendants' infringing activities.

44. Plaintiffs provided notice of infringement of the '292 Patent to all Defendants (other than Teguh Salim and Toupan Salim), but Defendants thereafter continued to infringe the patent. On information and belief, Defendants' infringement has been and continues to be willful.

SECOND CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. 6,928,779

45. The allegations set forth in the foregoing paragraphs are incorporated into this Second Claim for Relief.

46. On August 16, 2005, U.S. Patent No. 6,928,779 ("the '779 patent"), entitled "Floor Panel With Edge Connectors" was duly and legally issued by the

United States Patent and Trademark Office. A true and correct copy of the '779 Patent is attached as **Exhibit D** to this First Amended Complaint.

47. Plaintiffs are the assignee and owner of the right, title and interest in and to the '779 Patent, including the right to assert all causes of action arising under said patent and the right to any remedies for infringement of it.

48. In violation of 35 U.S.C. § 271, Defendants have directly infringed and continue to directly infringe, literally and /or under the doctrine of equivalents, the '779 Patent by importing, using, selling and/or offering for sale in the United States, including in this Judicial District, mechanically locking laminated floor panel products that embody or infringe the '779 Patent ("the '779 Accused Products and Services"), without the authority of Plaintiffs.

49. Plaintiffs provided actual notice to Defendant Tropical Flooring of its infringement of the '779 Patent in multiple letters, the earliest dated September 2008.

50. Plaintiffs provided actual notice to Defendant Maximus Flooring of its infringement of the '779 Patent in multiple letters, the earliest dated February 2012.

51. Plaintiffs provided actual notice to Defendant KC Industries Co. of its infringement of the '779 Patent in multiple letters, the earliest dated November 2011.

52. All Defendants (other than Teguh Salim and Toupan Salim) have had actual knowledge of the '779 Patent and their infringement of that patent since at least the date that the letters were received by Defendants and/or their related entities.

53. Upon information and belief, all Defendants (other than Teguh Salim and Toupan Salim) have committed and continue to commit acts of contributory infringement of the '779 patent under 35 U.S.C. § 27l(c) by selling, offering to sell, and/or importing products including the '779 Accused Products and Services for the '779 Patent, knowing or willfully blind to the fact that these products and

service constitute a material part of the invention, were especially made or especially adapted for use in an infringement of the '779 Patent, and have no substantial non-infringing uses.

54. Upon information and belief, since at least the date they received the notice letter from Plaintiffs, notifying Defendants that their products infringed the '779 Patent, all Defendants (other than Teguh Salim and Toupan Salim) have induced and continue to induce others to infringe the '779 Patent under 35 U.S.C. § 271(b) by, among other things, and with specific intent, actively and knowingly aiding and abetting others to infringe, including, but not limited to, Defendants' customers whose use of the '779 Accused Services and Products constitutes direct infringement of the '779 Patent. In particular, Defendants acted with specific intent to make others, such as its customers, infringe by advertising and selling the products and by providing written instructions instructing customers on how to assemble and use the products. On information and belief, Defendants engaged in such actions with specific intent to cause infringement or with willful blindness to the resulting infringement because Defendants have had actual knowledge of the '779 Patent and that its acts were inducing its customers to infringe the '779 Patent.

55. Plaintiffs have been harmed by Defendants' infringing activities.

56. Plaintiffs provided notice of infringement of the '779 Patent to all Defendants (other than Teguh Salim and Toupan Salim), but Defendants thereafter continued to infringe the patent. On information and belief, Defendants' infringement has been and continues to be willful.

THIRD CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. 6,490,836

57. The allegations set forth in the foregoing paragraphs are incorporated into this Third Claim for Relief.

58. On December 10, 2002, U.S. Patent No. 6,490,836 ("the '836 patent"), entitled "Floor Panel With Edge Connectors" was duly and legally issued by the United States Patent and Trademark Office. A true and correct copy of the '836 Patent is attached as **Exhibit E** to this First Amended Complaint.

59. Plaintiffs are the assignee and owner of the right, title and interest in and to the '836 Patent, including the right to assert all causes of action arising under said patent and the right to any remedies for infringement of it.

60. In violation of 35 U.S.C. § 271, Defendants have directly infringed and continue to directly infringe, literally and /or under the doctrine of equivalents, the '836 Patent by importing, making, using, selling and/or offering for sale in the United States, including in this Judicial District, mechanically locking laminated floor panel products that embody or infringe the '836 Patent ("the '836 Accused Products and Services"), without the authority of Plaintiffs.

61. Plaintiffs provided actual notice to Defendant Tropical Flooring of its infringement of the '836 Patent in multiple letters, the earliest dated September 2008.

62. Plaintiffs provided actual notice to Defendant Maximus Flooring of its infringement of the '836 Patent in multiple letters, the earliest dated February 2012.

63. Plaintiffs provided actual notice to Defendant KC Industries Co. of its infringement of the '836 Patent in multiple letters, the earliest dated November 2011.

64. All Defendants (other than Teguh Salim and Toupan Salim) have had actual knowledge of the '836 Patent and their infringement of that patent since at least the date that the letters were received by Defendants and/or their related entities.

65. Upon information and belief, all Defendants (other than Teguh Salim and Toupan Salim) have committed and continue to commit acts of contributory infringement of the '836 patent under 35 U.S.C. § 27l(c) by selling, offering to sell,

and/or importing products including the '836 Accused Products and Services for the '836 Patent, knowing or willfully blind to the fact that these products and service constitute a material part of the invention, were especially made or especially adapted for use in an infringement of the '836 Patent, and have no substantial non-infringing uses.

66. Upon information and belief, since at least the date they received the notice letter from Plaintiffs, notifying Defendants that their products infringed the '836 Patent, all Defendants (other than Teguh Salim and Toupan Salim) have induced and continue to induce others to infringe the '836 Patent under 35 U.S.C. § 271(b) by, among other things, and with specific intent, actively and knowingly aiding and abetting others to infringe, including, but not limited to, Defendants' customers whose use of the '836 Accused Services and Products constitutes direct infringement of the '836 Patent. In particular, Defendants acted with specific intent to make others, such as its customers, infringe by advertising and selling the products and by providing written instructions instructing customers on how to assemble and use the products. On information and belief, Defendants engaged in such actions with specific intent to cause infringement or with willful blindness to the resulting infringement because Defendants have had actual knowledge of the '836 Patent and that its acts were inducing its customers to infringe the '836 Patent.

67. Plaintiffs have been harmed by Defendants' infringing activities.

68. Plaintiffs provided notice of infringement of the '836 Patent to all Defendants (other than Teguh Salim and Toupan Salim), but Defendants thereafter continued to infringe the patent. On information and belief, Defendants' infringement has been and continues to be willful.

JURY DEMAND

69. Pursuant to Rule 38 of the Federal Rules of Civil Procedure, Plaintiffs demand a trial by jury on all issues triable as such.

PRAYER FOR RELIEF

70. WHEREFORE, Plaintiffs respectfully request that this Court enter judgment in their favor and against Defendants as follows:

a. An adjudication that Defendants have infringed the '292, '779, and '836 patents;

b. A permanent injunction against continued patent infringement by the Defendants pursuant to 35 U.S.C. Section 283 or failing that an ongoing royalty to compensate Plaintiffs for any sales made post-judgment;

c. An award of damages to be paid by Defendants adequate to compensate Plaintiffs for Defendants' past infringement of the '292, '779, and '836 patents and any continuing or future infringement through the date such judgment is entered, including interest, costs, expenses and an accounting of all infringing acts including, but not limited to, those acts not presented at trial;

d. A declaration that this case is exceptional under 35 U.S.C. § 285, and an award of Plaintiffs reasonable attorneys' fees; and

e. An award of treble damages under 35 U.S.C. § 284.

Dated: June 27, 2014

LEE TRAN & LIANG LLP

Enoch H. Liang
Attorneys for Plaintiffs Unilin Beheer B.V. and Flooring Industries, LTD Sarl

EXHIBIT A

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

In the Matter of	)	
CERTAIN LAMINATED FLOOR PANELS	)	**Inv. No. 337-TA-545**

NOTICE OF FINAL DETERMINATION; ISSUANCE OF GENERAL EXCLUSION ORDER AND CEASE AND DESIST ORDERS; TERMINATION OF INVESTIGATION

AGENCY: U.S. International Trade Commission.

ACTION: Notice.

SUMMARY: Notice is hereby given that the U.S. International Trade Commission has found a violation of section 337 of the Tariff Act of 1930 (19 U.S.C. § 337) based on the infringement of nine asserted claims of three asserted patents and has issued a general exclusion order and cease and desist orders in the above-captioned investigation. The investigation is terminated.

FOR FURTHER INFORMATION CONTACT: Michael Haldenstein, Office of the General Counsel, U.S. International Trade Commission, 500 E Street, S.W., Washington, D.C. 20436, telephone (202) 205-3041. Copies of all nonconfidential documents filed in connection with this investigation are or will be available for inspection during official business hours (8:45 a.m. to 5:15 p.m.) in the Office of the Secretary, U.S. International Trade Commission, 500 E Street, S.W., Washington, D.C. 20436, telephone 202-205-2000. General information concerning the Commission may also be obtained by accessing its Internet server (http://www.usitc.gov). The public record for this investigation may be viewed on the Commission's electronic docket (EDIS) at http://edis.usitc.gov. Hearing-impaired persons are advised that information on this matter can be obtained by contacting the Commission's TDD terminal on 202-205-1810.

SUPPLEMENTARY INFORMATION: The Commission instituted this investigation on July 29, 2005, based on a complaint filed by Unilin Beheer B.V., Flooring Industries Ltd., and Unilin Flooring N.C. LLC (collectively "Unilin"). 70 *Fed. Reg.* 44694 (August 3, 2005). The complaint (as amended) alleged violations of section 337 of the Tariff Act of 1930 ("section 337") in the importation into the United States, the sale for importation, and the sale within the United States after importation of certain laminated floor panels by reason of infringement of one

or more of claims 1, 14, 17, 19, 20, 21, 37, 52, 65, and 66 of U.S. Patent No. 6,006,486 ("the '486 patent"), claims 1, 2, 10, 13, 18, 19, 22, 23, 24, and 27 of U.S. Patent No. 6,490,836 ("the '836 patent"), claims 1-6 of U.S. Patent No. 6,874,292 ("the '292 patent"), and claims 1, 5, 13, 17, 27, and 28 of U.S. Patent No. 6,928,779 ("the '779 patent"). The investigation was subsequently terminated with respect to the '486 patent. The Commission named as respondents 32 companies located in Canada, China, South Korea, Malaysia, and the United States. *Id.* Two respondents have been terminated from the investigation as a result of settlement agreements.

On July 3, 2006, the ALJ issued his final initial determination ("ID"), including his recommended determination on remedy and bonding. The complainants, the Commission investigative attorney ("IA"), and several respondents petitioned for review of various portions of the final ID.

On September 25, 2006, after considering the final ID, the written submissions and other relevant portions of the record, the Commission determined to review those portions of the ALJ's final ID concerning: (1) construction of the "elastically bendable portion" limitation of claim 1 of the '836 patent and claim 4 of the '292 patent, (2) infringement of claims 1 and 2 of the '836 patent and claims 3 and 4 of the '292 patent; (3) infringement by the defaulting respondents; (4) invalidity of the asserted claims of the '779 patent; and (5) the validity of the asserted claims of the '836 and '292 patents to the extent implicated by the Commission's review described in item (1). The Commission received written submissions on the issues under review and on remedy, the public interest, and bonding.

Having examined the record in this investigation, including the submissions on review and responses thereto, the Commission has determined that there is a violation of section 337 with respect to claims 1, 2, 10, 18, and 23 of the '836 patent, claims 3 and 4 of the '292 patent, and claims 5 and 17 of the '779 patent.

The Commission has also made determinations on the issues of remedy, the public interest, and bonding. The Commission has determined that the appropriate form of relief is a general exclusion order prohibiting the unlicensed entry of laminated floor panels covered by claims 1, 2, 10, 18, and 23 of the '836 patent, claims 3 and 4 of the '292 patent, and claims 5 and 17 of the '779 patent. The Commission has also determined to issue cease and desist orders limited to claim 1 of the '836 patent and directed to defaulting domestic respondents Dalton Carpet Liquidators, Inc., Pacific Flooring Manufacture, Inc., P.J. Flooring Distributor, R.A.H. Carpet Supplies, Inc., Salvage Building Material, Inc., Stalheim (USA), Inc., Universal Floor Covering, Inc., and Vegas Laminate Hardwood Floors LLC.

The Commission has determined that the public interest factors enumerated in 19 U.S.C. § 1337(d), (f), and (g) do not preclude issuance of the aforementioned remedial orders, and that the bond during the Presidential period of review shall be set at 100 percent of the entered value for any covered laminated floor panels.

The authority for the Commission's determinations is contained in section 337 of the Tariff Act of 1930, as amended (19 U.S.C. § 1337), and in sections 210.45 - 210.51 of the Commission's Rules of Practice and Procedure (19 C.F.R. §§ 210.45 - 210.51).

By order of the Commission.

Marilyn R. Abbott
Secretary to the Commission

Issued: January 5, 2007

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

In the Matter of **CERTAIN LAMINATED FLOOR PANELS**	**Inv. No. 337-TA-545**

GENERAL EXCLUSION ORDER

The Commission has determined that there is a violation of section 337 of the Tariff Act of 1930 (19 U.S.C. § 1337) in the unlawful importation and sale of certain laminated floor panels that infringe claims 1, 2, 10, 18, and 23 of U.S. Patent No. 6,490,836 ("the '836 patent"), claims 3 and 4 of U.S. Patent No. 6,874,292 ("the '292 patent"), and claims 5 and 17 of U.S. Patent No. 6,928,779 ("the '779 patent").

Having reviewed the record in this investigation, including the written submissions of the parties, the Commission has made its determination on the issues of remedy, the public interest, and bonding. The Commission has determined that a general exclusion from entry for consumption is necessary to prevent circumvention of an exclusion order limited to products of named persons and because there is a pattern of violation of section 337 and it is difficult to identify the source of the infringing products. Accordingly, the Commission has determined to issue a general exclusion order prohibiting the importation of infringing laminated floor panels. The Commission has further determined that the public interest factors enumerated in 19 U.S.C. § 1337(d) do not preclude issuance of the general exclusion order, and that the bond during the Presidential review period shall be in the amount of 100 percent of the entered value of the articles in question.

Accordingly, the Commission hereby **ORDERS** that:

1. Laminated floor panels covered by one or more of claims 1, 2, 10, 18, and 23 of the '836 patent, claims 3 and 4 of the '292 patent, and claims 5 and 17 of the '779 patent are excluded from entry into the United States for consumption, entry for consumption from a foreign trade zone, or withdrawal from warehouse for consumption, for the remaining term of the listed patents, except under license of the patent owner or as provided by law.

2. This Order does not apply to articles that are imported or manufactured abroad by any of the following entities: Armstrong World Industries, Inc.; Alloc, Inc.; Beaulieu International Group; or Valinge Innovation AB.

3. Pursuant to procedures to be specified by U.S. Customs and Border Protection (Customs), as U.S. Customs and Border Protection deems necessary, persons seeking to import laminated floor panels that are potentially subject to this Order shall certify that they are familiar with the terms of this Order, that they have made appropriate inquiry, and thereupon state that, to the best of their knowledge and belief, the products being imported are not excluded from entry under paragraph 1 of this Order. At its discretion, U.S. Customs and Border Protection may require persons who have provided the certification described in this paragraph to furnish such records or analyses as are necessary to substantiate the certification.

4. Notwithstanding paragraph 1 of this Order, the aforesaid laminated floor panels are entitled to entry into the United States for consumption, entry for consumption from a foreign trade zone, or withdrawal from a warehouse for consumption, under bond in the amount of 100 percent of entered value pursuant to subsection (j) of section 337 of the Tariff Act of 1930, as amended (19 U.S.C. § 1337(j)) and the Presidential Memorandum for the United States Trade Representative of July 21, 2005 (70 Fed. Reg. 43251), from the day after this Order is received by the United States Trade Representative until such time as the United States Trade Representative notifies the Commission that this Order is approved or disapproved but, in any event, not later than 60 days after the date of receipt of this Order.

5. In accordance with 19 U.S.C. § 1337(l), the provisions of this Order shall not apply to laminated floor panels that are imported by and for the use of the United States, or imported for, and to be used for, the United States with the authorization or consent of the Government.

6. The Commission may modify this Order in accordance with the procedures described in section 210.76 of the Commission's Rules of Practice and Procedure (19 C.F.R. § 210.76).

7. The Secretary to the Commission shall serve copies of this Order upon each party of record in this investigation and upon the Department of Health and Human Services, the Department of Justice, the Federal Trade Commission, and U.S. Customs and Border

Protection.

8. Notice of this Order shall be published in the *Federal Register*.

By Order of the Commission.

Marilyn R. Abbott
Secretary to the Commission

Issued: January 5, 2007

EXHIBIT B

535 F.3d 1322
United States Court of Appeals,
Federal Circuit.

YINGBIN–NATURE (GUANGDONG) WOOD INDUSTRY CO., LTD. (also known as Yingbin (Shunde–Foshan) Wood Industry Co., Ltd.), and Jiangsu Lodgi Wood Industry Co., Ltd., Appellants,
v.
INTERNATIONAL TRADE COMMISSION, Appellee.
and
Unilin Beheer B.V., Flooring Industries, Ltd., and Unilin Flooring N.C. LLC, Intervenors.

No. 2007–1311. | July 31, 2008.

Synopsis

Background: Importer of laminate floor panels that allegedly infringed three patents directed at a mechanism for coupling adjacent panels of laminate flooring without requiring permanent attachment appealed the decision of the International Trade Commission (ITC) finding infringement violated the Tariff Act and issuing a general exclusion order.

Holdings: The Court of Appeals, Schall, Circuit Judge, held that:

[1] importer's challenge to validity of patent's clearance claims was not moot;

[2] portion of importer's appeal regarding infringement of claims of patents requiring an elastically bendable portion of the lower lip was moot; and

[3] substantial evidence supported Commission's conclusion that clearance claims of patent were adequately described in originally-filed disclosure.

Affirmed.

Attorneys and Law Firms

***1324** E. Joshua Rosenkranz, Heller Ehrman LLP, of New York, New York, argued for appellants. With him on the brief were Sturgis M. Sobin and Alexander D. Chinoy, of Washington, DC, and Randy J. Kozel, of Madison, WI.

James A. Worth, Attorney, Office of the General Counsel, United States International Trade Commission, of Washington, DC, argued for appellee. With him on the brief were James M. Lyons, General Counsel, Wayne W. Herrington, Assistant General Counsel for Litigation, and Michael K. Haldenstein, Attorney.

John M. DiMatteo, Willkie Farr & Gallagher LLP, of New York, NY, argued for intervenors. With him on the brief were Steven H. Reisberg, Leslie M. Spencer, Alexander H. Swirnoff, and David A. Benner. Of counsel was Margaret D. Macdonald, Howrey LLP, of Washington, DC.

Before MICHEL, Chief Judge, SCHALL and DYK, Circuit Judges.

Opinion

***1325** SCHALL, Circuit Judge.

Unilin Beheer B.V. Flooring Industries, Ltd. and Unilin Flooring N.C. LLC (collectively "Unilin") filed a complaint with the United States International Trade Commission ("the Commission") under section 337 of the Tariff Act of 1930, 19 U.S.C. § 1337(a)(1)(B), alleging that thirty-two companies imported and sold laminate floor panels which infringed certain claims of U.S. Patent Nos. 6,490,836 ("the #836 patent"), 6,874,292 ("the #292 patent"), and 6,928,779 ("the #779 patent"). Three of those companies originally were parties to this appeal: Power Dekor Group Co., Ltd. ("Power Dekor Group"), Yingbin–Nature Wood Industry Co., Ltd., and Jiangsu Lodgi Wood Industry Co., Ltd. (collectively "Power Dekor"). [1]

The presiding administrative law judge ("ALJ") conducted an investigation into infringement and validity of the asserted claims. As relevant here, the ALJ concluded (1) that each of the Power Dekor products under investigation did not infringe claims 1 and 2 of the #836 patent or claims 3 and 4 of the #292 patent; and (2) that claims 5 and 17 of the #779 patent were invalid under 35 U.S.C. § 112 ¶ 1 for lack of written description support in the originally filed disclosure; and (3) that each of the Power Dekor products under investigation infringed one or more of claims 10, 18, and 23 of the # 836 patent. *In re Certain Laminated Floor Panels*, Inv. No. 337–TA–545 (Int'l Trade Comm'n July 3, 2006) ("*ALJ Determination* "). The Commission reversed with respect to the first two issues, concluding (1) that Unilin

had proven that Power Dekor's products infringed claims 1 and 2 of the #836 patent and claims 3 and 4 of the #292 patent; and (2) that claims 5 and 17 of the #779 patent satisfied the written description requirement and were therefore not invalid. *In re Certain Laminated Floor Panels*, Inv. No. 337–TA–545 (Int'l Trade Comm'n Jan. 5, 2007) ("*Commission Opinion* "). Based on these conclusions and the ALJ's finding that each of the Power Dekor products infringed one or more of claims 10, 18, and 23 of the #836 patent, which was not reviewed, the Commission determined that there was a violation of section 337 and issued a general exclusion order under 19 U.S.C. § 1337(d)(2). Because the Commission's conclusions are supported by substantial evidence, we affirm.

BACKGROUND

I.

Each of the patents at issue descends from U.S. Patent Application Serial No. 08/872,044 ("the #044 application"), which was filed on June 10, 1997, and ultimately issued as U.S. Patent No. 6,006,486 ("the #486 patent"). The # 836 patent issued on December 10, 2002, from a continuation of the #044 application. The #292 and #779 patents issued on April 5, 2005, and August 16, 2005, respectively, from continuations of the application that resulted in the #836 patent.

The patents are directed at a mechanism for coupling adjacent panels of laminate flooring without requiring permanent attachment—i.e., without the use of adhesives and/or nails. The patents teach that the coupling mechanism is substantially in the form of an interlocking tongue and groove. *See* #836 patent Abstract; #292 patent Abstract; #779 patent Abstract. Figure 23, included in all three patents, illustrates an embodiment of the patented coupling mechanism.

***1326 Fig. 23**

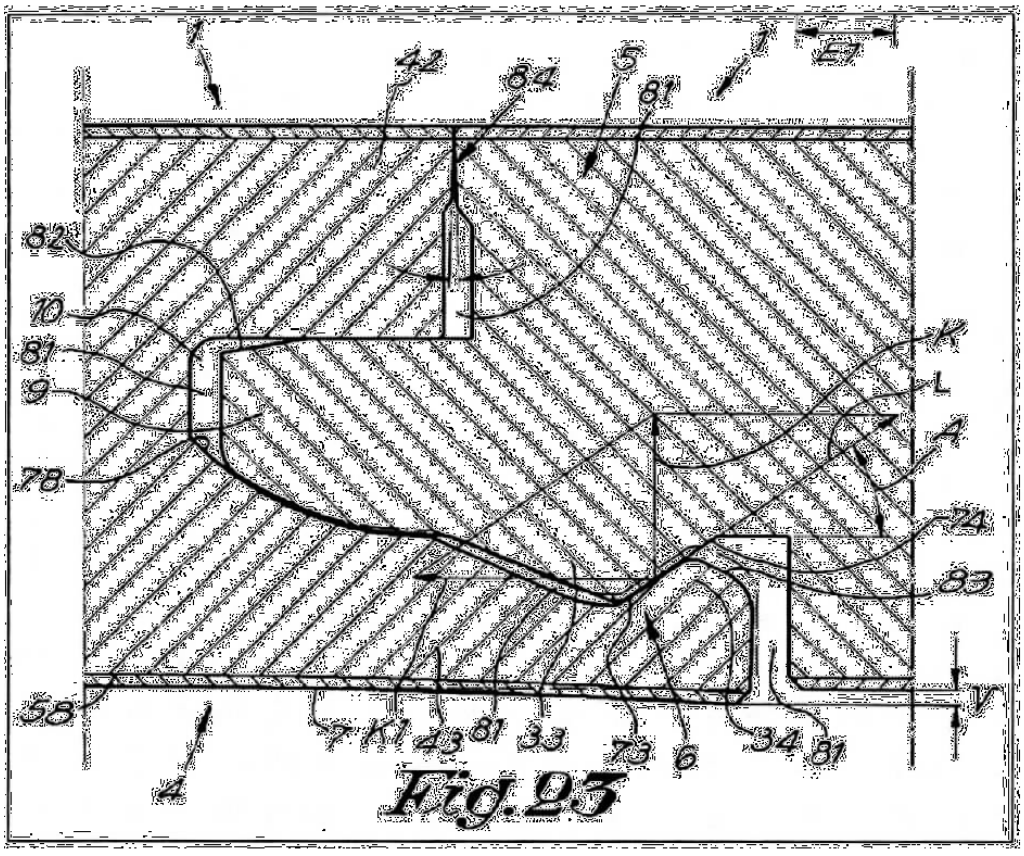


Fig. 23

An important feature of the invention is the extent to which the coupling mechanism counteracts the formation of gaps between adjacent floor panels. *E.g.*, #836 patent col.2 ll.34–41. To that end, the patents provide for a compression force component **K1** that draws adjacent floor panels toward each

other. *E.g.*, *id.* col.10 ll.23–27. In one embodiment, a portion of the lower lip **43** of the groove is inclined at angle **A.** In the inclined portion, the lower lip of the groove contacts the tongue **9** along a common plane of tangency **L.** The tongue is shaped such that, upon insertion into the groove, the lower lip of the groove is displaced a small distance **V** from its original position. *E.g.*, *id.* col.10 ll.2–9. Further, the lower lip is described as having an "elastically yieldable or bendable portion," whereby the lower lip tends to return to its original position when displaced. *E.g.*, *id.* Thus, when the tongue and the groove are coupled together, the lower lip of the tongue exerts a force against the groove along the common plane of tangency **L.** The horizontal component of this force comprises the compression force component **K1** that draws adjacent floor panels toward each other, counteracting the formation of gaps.

Another important aspect of the invention—as claimed in the #779 patent in particular—is the inclusion of voids, or "clearances," (e.g., the open spaces marked **81** in Figure 23) in certain locations between the tongue and groove of adjacent floor panels. According to the #779 patent, the voids ensure proper engagement between the tongue and the groove—e.g., by providing a space for stray dust or debris to collect during insertion of the tongue into the groove. *E.g.*, #779 patent col.6 ll.15–20, col. 7 ll.56–63.

II.

On July 1, 2005, Unilin filed a complaint with the Commission under section 337, alleging that thirty respondents imported and sold laminated floor panels that infringed various claims of the #486 patent, the #836 patent, and the #292 patent. The Commission initiated its investigation on July 29, 2005. *See* In re Certain Laminated Floor Panels, 70 Fed.Reg. 44,694 (Int'l Trade Comm'n Aug. 3, 2005) (Notice of Investigation). Unilin later moved to terminate the investigation with respect to the #486 patent, *Commission Opinion* at 2, and added two respondents as well as claims of infringement with respect to the #779 patent, *see* ***1327** In re Certain Laminated Floor Panels, 70 Fed.Reg. 61,309 (Int'l Trade Comm'n Oct. 21, 2005). Unilin also subsequently limited its assertions of infringement to claims 1, 2, 10, 18, and 23 of the #836 patent, claims 3 and 4 of the #292 patent, and claims 5 and 17 of the #779 patent. *Commission Opinion* at 2–3.

The ALJ conducted an evidentiary hearing on April 3–8 and April 10–11, 2006, and subsequently issued an exhaustive "Final Initial and Recommended Determination" on July 3, 2006. *ALJ Determination.* As relevant here, the ALJ determined that numerous products of the 32 respondents, including all seven Power Dekor products under investigation, infringed one or more of claims 10, 18, and 23 of the #836 patent. *Id.* at 105–23. These claims are collectively termed the "snap action claims" because they require a "snap action" effect upon coupling, which the ALJ construed as "a physical action that takes place when an elastically bendable portion of one panel bends during coupling to allow the joint to come together and after coupling the bendable portion returns towards its original position when the locking elements are engaged." *Id.* at 59.

In addition, the ALJ construed the limitation of claims 1 and 2 of the # 836 patent and claims 3 and 4 of the #292 patent (collectively "the lower lip claims") requiring an "elastically bendable portion" of the lower lip. The ALJ determined that claim 2 of the #836 patent and claim 3 of the #292 patent require elastic bending anywhere on the lower lip of the floor panel. *Id.* at 97, 99. The ALJ determined that claim 1 of the #836 patent and claim 4 of the #292 patent, however, require elastic bending limited to a specific location of the lower lip: between the deepest point of the groove and the lowermost bottom area of the recess (i.e., approximately between the areas labeled **78** and **73** in Figure 23). *Id.* at 51, 54–55. With respect to these latter two claims, the ALJ determined that bending cannot be shown in any area outside of the claimed location. *Id.*

Under this construction of the "elastically bendable portion" limitation, the ALJ determined that Power Dekor's products did not infringe the lower lip claims. Specifically, the ALJ concluded that Unilin had not met its burden of proving infringement because the tests performed by Unilin's expert, Dr. Loferski, were unreliable. *Id.* at 95–103. Alternatively, even if Dr. Loferski's tests were deemed reliable, the ALJ stated that those tests would nevertheless be insufficient to prove infringement of claim 1 of the #836 patent and claim 4 of the #292 patent. *Id.* at 103–05. That was because Dr. Loferski simply measured the relative distance that the distal (or tip) end of the lower lip of each accused product was displaced during coupling—i.e., he recorded the measurement denoted with a "V" in Figure 23. *Id.* at 104. According to the ALJ, however, displacement at the distal end of the lower lip did not prove that the lower lip bent in the specific area required by claim 1 of the #836 patent and claim

4 of the #292 patent. *Id.* In so concluding, the ALJ rejected Unilin's theory that the lower lip of the accused products could be analyzed as a cantilever beam, which necessarily bends throughout its entire length. *Id.*

Also relevant here, the ALJ concluded that claims 5 and 17 of the #779 patent ("the clearance claims") were invalid because they failed the written description requirement of 35 U.S.C. § 112 ¶ 1. *Id.* at 27–37. Specifically, the ALJ determined that there was no written description support for the later-claimed concept of "clearances" in the originally-filed disclosure (the #044 application). The ALJ focused on certain amendments that were made to the originally-filed specification, wherein the applicant used the term "clearance" to describe various areas of ***1328** the floor panels that had been previously referred to by three separate terms: (1) "recess," (2) "space" or "intermediate space," and (3) "chamber" or "dust chamber." *Id.* at 28–29. According to the ALJ, nothing in the originally-filed specification indicated that these three different spaces could be treated the same. *Id.* at 33. The ALJ determined that this all-encompassing "clearance" concept constituted new matter, as did the applicant's re-labeling of certain figures to show clearance locations that were not previously identified. *Id.* at 34–35. Because the clearance claims were not supported by the originally-filed written description, the ALJ concluded that they were invalid under 35 U.S.C. § 112 ¶ 1. *Id.* at 36.

After receiving petitions for review from Unilin, several respondents, and the investigative attorney ("IA"), the Commission determined to review several of the ALJ's conclusions, including (1) the construction of claim 1 of the #836 patent and claim 4 of the #292 patent, (2) infringement of claims 1 and 2 of the #836 patent and claims 3 and 4 of the #292 patent, and (3) invalidity of the asserted claims of the #779 patent. *See* In re Certain Laminated Floor Panels, 71 Fed.Reg. 57,564, 57,565 (Int'l Trade Comm'n Sept. 29, 2006) (Notice of Commission Determination to Review Portions of a Final Initial Determination). The ALJ's findings with respect to infringement of the snap action claims were not reviewed by the Commission, and thus, those findings became part of the Commission's final determination. *See* 19 C.F.R. § 210.42(h).

The Commission concluded that the ALJ erred in construing claim 1 of the # 836 patent and claim 4 of the #292 patent to require the absence of bending outside of the specified area of the lower lip—i.e., between the deepest point of the groove and the lowermost bottom area of the recess of the lower lip (approximately between the areas labeled **78** and **73** in Figure 23). *Commission Opinion* at 6. According to the Commission, "bending in the lower lip must occur in the elastically bendable portion but that bending is not prohibited elsewhere in the lower lip." *Id.*

The Commission also reversed the ALJ's determination that Power Dekor's products did not infringe the lower lip claims. The Commission addressed at length the ALJ's concerns regarding Dr. Loferski's test methodology, ultimately concluding that the tests he performed were reliable. *Id.* at 7–14. The Commission stated: "In sum, we find the evidence demonstrates that Loferski's test was a reasonable method for testing the presence of a bent lower lip, and while his test may not have been perfect, neither [Power Dekor] nor the ALJ identified any significant sources of error in the test." *Id.* at 14. The Commission also rejected the ALJ's independent ground of non-infringement with respect to claim 1 of the #836 patent and claim 4 of the #292 patent. In particular, the Commission determined—after receiving supplemental briefing on the issue—that it was appropriate to analyze the lower lip of the accused products according to cantilever beam principles. *Id.* at 14–17. Thus, the Commission concluded that Unilin had proven that the lower lip of each accused product bent elastically throughout its length, including in the specific area required by claim 1 of the #836 patent and claim 4 of the # 292 patent. *Id.* at 17.

Next, the Commission reversed the ALJ's determination that the clearance claims were invalid for lack of written description. The Commission agreed with Unilin and the IA that the applicant merely introduced the term "clearance" as a generic term that encompassed areas that were—in the originally-filed disclosure— ***1329** separately described as spaces, chambers, and recesses in the coupling joints of the panels. *Id.* at 23–24. The Commission relied on *Schering Corp. v. Amgen Inc.*, 222 F.3d 1347 (Fed.Cir.2000), for the proposition that "the use of a new term by the patentee to describe what was already disclosed does not constitute new matter," *id.* at 1352. According to the Commission, the applicant's amendment to the application resulting in the #779 patent did not introduce new matter because it "did no more than label specific clearances and explain what was already shown in the specification and figures of the original application." *Commission Opinion* at 26. Thus, the Commission concluded that the originally-filed disclosure demonstrated that the applicant was in full possession of the subject matter of the clearance claims at the time that original disclosure was filed. The Commission determined that the clearance claims were not invalid under § 112 ¶ 1, finding

that the respondents had not proven invalidity by clear and convincing evidence. *Id.*

Finally, after reaching the foregoing conclusions regarding infringement and validity, the Commission considered the appropriateness of entering a general exclusion order—as opposed to a limited exclusion order directed only at the particular respondents' products under investigation. *Id.* at 26; *see* 19 U.S.C. § 1337(d)(2). The Commission "agree[d] with the ALJ's recommendation of a general exclusion order based on the ALJ's findings of a 'widespread pattern' of unauthorized use of the patented invention and the 'business conditions' prongs of the test for whether a general exclusion order is warranted." *Commission Opinion* at 28–29. Accordingly, the Commission entered a general exclusion order with respect to claims 1, 2, 10, 18, and 23 of the #836 patent, claims 3 and 4 of the #292 patent, and claims 5 and 17 of the #779 patent.

DISCUSSION

On appeal, Power Dekor challenges the Commission's determinations with respect to infringement of the lower lip claims and validity of the clearance claims. Power Dekor argues that substantial evidence supports neither (1) the Commission's conclusion that Power Dekor's products infringed the lower lip claims nor (2) its conclusion that the clearance claims were adequately described in the originally-filed disclosure. Power Dekor does not appeal the determination that all seven of its products under investigation infringed one or more of the snap action claims. We will address the merits of Power Dekor's appeal. First, however, we address a threshold question.

I.

Prior to oral argument, we sent a letter to the parties requesting that they prepare responses to a question that had not been sufficiently addressed in their respective briefs: whether the issues raised by Power Dekor on appeal to this court were moot. Specifically, we asked "[w]hether this case is moot because the accused products at issue in this appeal all infringe at least one of claims 10, 18, and 23 of U.S. Patent No. 6,490,836, and the general exclusion order is supported by the infringement of those claims." "Simply stated, a case is moot when the issues presented are no longer 'live' or the parties lack a legally cognizable interest in the outcome." *Powell v. McCormack*, 395 U.S. 486, 496, 89 S.Ct. 1944, 23 L.Ed.2d 491 (1969). Where the controversy between the parties has ended, the case becomes moot and will be dismissed, "[h]owever convenient it might be to have decided the question" for future cases. *United States v. Alaska S.S. Co.*, 253 U.S. 113, 116, 40 S.Ct. 448, 64 L.Ed. 808 (1920).

***1330** At oral argument, Unilin contended that the appeal is moot because the Commission determined that all seven [2] of Power Dekor's products infringed one or more of claims 10, 18, and 23 of the #836 patent ("the snap action claims"), and Power Dekor did not appeal that determination. In other words, Unilin argued that even if we agree with Power Dekor on the merits and reverse the Commission with respect to infringement of the lower lip claims and validity of the clearance claims, Power Dekor's products would still be excluded from the country based on the unappealed finding by the Commission that those products all infringed one or more of the snap action claims.

Power Dekor and the Commission argued that the appeal is not moot. That is because, according to Power Dekor, the controversy on appeal is not whether the seven Power Dekor products that were subject to investigation will be excluded from importation. Rather, Power Dekor contends that the controversy on appeal relates to the scope of the Commission's general exclusion order ("GEO"), which affects the type of products that Power Dekor will be permitted to import in the future. According to Power Dekor, it would like to import products that, under the Commission's rulings, do not infringe the snap action claims (claims 10, 18, and 23 of the #836 patent) but do infringe the lower lip claims (claims 1 and 2 of the #836 patent and claims 3 and 4 of the # 292 patent) and the clearance claims (claims 5 and 17 of the #779 patent). *See* Oral Arg. at 1:54–3:18, *available at* http://www.cafc.uscourts. gov/oralarguments/mp3/2007–1311.mp3. As examples of such products, Power Dekor points specifically to the products of two other respondents that are not parties to this appeal: (1) the "Lock 7" product of Vohringer Wood Product (Shanghai) Co. Ltd. and (2) the "Engagement 2" product of Yekalon Industry, Inc. According to Power Dekor, it desires to import such products in the future but, under the general exclusion order in its current form, it is prohibited from doing so. The Commission agreed with Power Dekor that the appeal is not moot because there is a live controversy about the scope of its general exclusion order.

A.

[1] **[2]** When the Commission determines that there has been a violation of section 337, it may issue one of two types of exclusion orders: a limited exclusion order or a general exclusion order. *See Fuji Photo Film Co., Ltd. v. Int'l Trade Comm'n,* 474 F.3d 1281, 1286 (Fed.Cir.2007). Both orders direct U.S. Customs and Border Protection ("Customs") to bar infringing products from entering the country. A limited exclusion order is "limited" in that it only applies to the specific parties before the Commission in the investigation. *Id.* In contrast, a general exclusion order bars the importation of infringing products by everyone, regardless of whether they were respondents in the Commission's investigation. *Id.* A general exclusion order may only be issued if (1) "necessary to prevent circumvention of a limited exclusion order," or (2) "there is a pattern of violation of this section and it is difficult to identify the source of infringing products." 19 U.S.C. § 1337(d)(2); *see id.*

Paragraph 1 of the general exclusion order issued by the Commission provides, in relevant part:

> ***1331** Accordingly, the Commission hereby ORDERS that ... [l]aminated floor panels covered by one or more of claims 1, 2, 10, 18, and 23 of the #836 patent, claims 3 and 4 of the #292 patent, and claims 5 and 17 of the # 779 patent are excluded from entry into the United States ... for the remaining term of the listed patents, except under license of the patent owner or as provided by law.

The Commission's order is typical of general exclusion orders, speaking in terms of patent claims rather than parties and/or infringing products. It directs Customs to exclude from entry any laminated floor panels that infringe one or more of claims 1, 2, 10, 18, and 23 of the #836 patent, claims 3 and 4 of the #292 patent, and claims 5 and 17 of the #779 patent. As the Commission recognized, however, it would be difficult for Customs to independently test each floor panel presented for importation to determine whether it was covered by the GEO. Thus, at the recommendation of the ALJ and the IA, the Commission included a "certification provision" in the GEO. The certification provision reads as follows:

> Pursuant to procedures to be specified by [Customs], as [Customs] deems necessary, persons seeking to import laminated floor panels that are potentially subject to this Order shall certify that they are familiar with the terms of this Order, that they have made appropriate inquiry, and thereupon state that, to the best of their knowledge and belief, the products being imported are not excluded from entry under paragraph 1 of this Order. At its discretion, [Customs] may require persons who have provided the certification described in this paragraph to furnish such records or analyses as are necessary to substantiate the certification.

B.

[3] First, we hold that Power Dekor's challenge to the validity of claims 5 and 17 of the #779 patent—the clearance claims—is not moot. The #836, # 292, and #779 patents all issued from continuations of the original #044 application. Because the #836 and #292 patents were granted no term extension, they both expire on June 10, 2017—twenty years from the date the # 044 application was filed. *See* 35 U.S.C. § 154(a)(2). The term of the # 779 patent, however, was extended by 108 days pursuant to 35 U.S.C. § 154(b). Thus, the #779 patent will expire 108 days after June 10, 2017. As noted above, the Commission determined that all seven Power Dekor products under investigation infringed at least one of claims 10, 18, and 23 of the # 836 patent—a finding that Power Dekor has not appealed. However, the Commission also determined that all seven of those products infringed at least one of claims 5 and 17 of the #779 patent. Therefore, under the general exclusion order, Power Dekor is currently prohibited from importing any of those seven products until the #779 patent expires 108 days after June 10, 2017. A successful challenge to the validity of claims 5 and 17 of the #779 patent would enable Power Dekor to begin importation 108 days earlier, promptly upon expiration of the #836 patent on June 10, 2017. For at least that reason, the portion of Power Dekor's appeal concerning validity of the clearance claims is not moot.

[4] For the following reasons, however, we hold that the portion of Power Dekor's appeal regarding infringement of claims 1 and 2 of the #836 patent and claims 3 and 4 of the #292 patent—the lower lip claims—is moot. As an initial matter, it is clear that the live controversy on appeal cannot be the exclusion of the seven Power Dekor products under investigation from entry into the United States. That exclusion is ***1332** fully supported by the Commission's determination that each of the seven products infringes at least one of claims 10, 18, and 23 of the #836 patent—the snap action claims—which was not appealed. In other words, any injury caused by the exclusion of those seven products would not be redressed by our determination, if appropriate, that the products do not infringe claims 1 and 2 of the #836 patent and claims 3 and 4 of the #292 patent.

Power Dekor concedes that the exclusion of its seven products from importation is not redressable by this court. Instead, it argues that the controversy on appeal relates to the scope of the Commission's general exclusion order—i.e., the inclusion of claims 1 and 2 of the #836 patent and claims 3 and 4 of the #292 patent in the GEO. The only injury to which Power Dekor points as resulting from the Commission's inclusion of the lower lip claims in the GEO is that it is prevented from importing products that do not infringe the snap action claims but that do infringe one or more of the lower lip claims. Of course, the fact that Power Dekor has no legal right to import products that infringe one or more of the lower lip claims is true regardless of whether those claims are listed in any general exclusion order. *See* 19 U.S.C. § 1337(a)(1)(B). Until the #836 and #292 patents expire, Power Dekor is not permitted to import products that *actually* infringe one or more of the lower lip claims, unless those claims are otherwise held invalid or unenforceable. The true nature of the injury that Power Dekor asserts lies in the potential collateral estoppel effect of the GEO—coupled with the Commission's conclusions regarding infringement of the products under investigation—upon a determination, in future proceedings, of *whether* there is infringement by similar products that Power Dekor presents for importation.

Power Dekor essentially argues that it will be precluded from importing products similar to Vohringer's "Lock 7" product and Yekalon's "Engagement 2" product because (1) the Commission's general exclusion order instructs Customs to exclude from entry any product that infringes one or more of the lower lip claims and (2) the Commission held that the "Lock 7" and "Engagement 2" products infringe one or more of those claims. Power Dekor contends that, if it is not permitted to seek resolution of the infringement issue in the present appeal, it will forever be barred from importing such products. Stated differently, the injury articulated by Power Dekor is that it will be collaterally estopped by the Commission's present rulings from arguing in future proceedings, whether before Customs or the Commission, that products similar to the "Lock 7" and "Engagement 2" products do not infringe the lower lip claims. We do not agree, however, that Power Dekor is injured by collateral estoppel.

The factual findings of infringement that were adverse to the other parties (Vohringer and Yekalon) in this investigation will not bind Power Dekor in future proceedings. *See Comair Rotron, Inc. v. Nippon Densan Corp.*, 49 F.3d 1535, 1537 (Fed.Cir.1995) (noting that, in order for collateral estoppel to apply, "the party against whom estoppel is sought [must have] had a full and fair opportunity to litigate the issue" in the prior action). The Commission's factual findings that the "Lock 7" and "Engagement 2" products infringe the lower lip claims are only preclusive as to Vohringer and Yekalon, respectively.

In addition, we do not think that, under the circumstances, the Commission's determinations of infringement with respect to the seven Power Dekor products under investigation should have preclusive effect ***1333** against other products presented by Power Dekor for importation at a future date—e.g., if Power Dekor attempts to design around the unappealed infringement by those seven products of the snap action claims. First, we note that proof of infringement by collateral estoppel is only appropriate in limited circumstances, where it is shown that a close identity exists between the relevant features of the accused device and the device previously determined to be infringing. *See Acumed LLC v. Stryker Corp.*, 525 F.3d 1319, 1324 (Fed.Cir.2008) (noting that claim preclusion does not apply with respect to infringement unless the accused device and the device previously held infringing are "essentially the same," meaning that the differences between them are merely "colorable" or "unrelated to the limitations in the claim of the patent" (citations omitted)); *see also Del Mar Avionics, Inc., v. Quinton Instrument Co.*, 836 F.2d 1320, 1324 (Fed.Cir.1987) (holding that claim preclusion did not apply because a "device not previously before the court, and shown to differ from those structures previously litigated, requires a determination on its own facts"); *Young Engineers, Inc. v. Int'l Trade Comm'n*, 721 F.2d 1305, 1316 (Fed.Cir.1983) (refusing to find noninfringement by way of collateral estoppel, where the accused infringer made no attempt to establish that the

device in question was the same as the device previously held noninfringing).

Here, infringement of the unappealed snap action claims appears related, in part, to infringement of the lower lip claims. For example, the ALJ interpreted the snap action claims as requiring "a physical action that takes place when an *elastically bendable portion* of one panel bends during coupling to allow the joint to come together and after coupling the *bendable portion* returns towards its original position when the locking elements are engaged." *ALJ Determination* at 59 (emphases added). In other words, it is the "elastically bendable" property of the lower lip of the accused products that contributes to the claimed "snap action" coupling effect. Power Dekor apparently proposes to avoid infringement of the snap action claims by altering the tongue-and-groove structure of its future products, such that those products are coupled by rotational assembly—like the "Lock 7" and "Engagement 2" products—rather than assembly via the "snap action" that occurs when two panels are laterally shifted toward each other.[3] There has been no showing that collateral estoppel will apply to Power Dekor's future products in view of these structural changes—i.e., that Power Dekor's future products will be "essentially the same" as those previously determined by the Commission to infringe the lower lip claims.

Finally, the prospect of collateral estoppel seems especially diminished where, as here, proof of infringement requires more than a passing observation of the accused device's structure. Claims 1 and 2 of the #836 patent and claims 3 and 4 of the #292 patent require that the lower lip of an accused floor panel have an "elastically bendable portion," the proof of which presumably requires significant expert testing. Indeed, all of Power Dekor's arguments here with respect to infringement center on the propriety of Dr. Loferski's ***1334** method of testing the lower lip of each of its products for an "elastically bendable portion."

[5] In sum, we conclude that the Commission's findings with respect to infringement of the lower lip claims can give Power Dekor "no reasonable concern about preclusive effect." *Sea–Land Serv., Inc. v. Dep't of Transp.*, 137 F.3d 640, 649 (D.C.Cir.1998). There is simply no reason why Power Dekor, at a future date, will be positioned differently vis-à-vis any other foreign company when presenting laminate floor panels for importation. Panels that infringe one or more of the claims included in the GEO will be excluded; those that do not infringe will be allowed entry into the United States. The Commission's findings of infringement with respect to the lower lip claims in this investigation will have no preclusive effect on Power Dekor in future import proceedings.[4] Therefore, we conclude that Power Dekor has failed to allege an actual injury caused by the inclusion of those claims in the GEO, and we decline to address Power Dekor's arguments relating to infringement.

II.

[6] Finally, we address Power Dekor's contentions that the clearance claims are invalid for lack of adequate written description in the originally-filed disclosure. The first paragraph of Section 112 of the Patent Act provides, in pertinent part:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same....

35 U.S.C. § 112 ¶ 1. "We have interpreted that section as requiring a 'written description' of an invention separate from enablement." *Enzo Biochem, Inc. v. Gen–Probe Inc.*, 323 F.3d 956 (Fed.Cir.2002) (citing *Vas–Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1563 (Fed.Cir.1991)).

[7] **[8]** "In order to satisfy the written description requirement, the disclosure as originally filed does not have to provide in haec verba support for the claimed subject matter at issue." *Purdue Pharma L.P. v. Faulding Inc.*, 230 F.3d 1320, 1323 (Fed.Cir.2000) (citing *Fujikawa v. Wattanasin*, 93 F.3d 1559, 1570 (Fed.Cir.1996)). Nonetheless, "the disclosure of the prior application must 'convey with reasonable clarity to those skilled in the art that, as of the ***1335** filing date sought, [the inventor] was in possession of the invention.' " *PowerOasis, Inc. v. T–Mobile USA, Inc.*, 522 F.3d 1299, 1306 (Fed.Cir.2008) (quoting *Vas–Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1563–64 (Fed.Cir.1991)); *see also id.* That inquiry is a factual one and must be assessed on a case-by-case basis. *Purdue Pharma*, 230 F.3d at 1323.

[9] **[10]** We review the Commission's factual findings under the substantial evidence standard. 19 U.S.C. § 1337(c); 5 U.S.C. § 706(2)(E). Thus, we review for substantial evidence the Commission's determination that claims 5 and 17 of the #779 patent satisfy the written description requirement of 35 U.S.C. § 112 ¶ 1. Substantial evidence is "such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." *Enercon GmbH v. Int'l Trade Comm'n,* 151 F.3d 1376, 1381 (Fed.Cir.1998) (quoting *Consol. Edison Co. v. Nat'l Labor Relations Bd.,* 305 U.S. 197, 229, 59 S.Ct. 206, 83 L.Ed. 126 (1938)). It is "more than a mere scintilla," *Consol. Edison,* 305 U.S. at 229, 59 S.Ct. 206, but "something less than the weight of the evidence," *Consolo v. Fed. Maritime Comm'n,* 383 U.S. 607, 619–20, 86 S.Ct. 1018, 16 L.Ed.2d 131 (1966). Importantly, "the possibility of drawing two inconsistent conclusions from the evidence does not prevent an administrative agency's finding from being supported by substantial evidence." *Id.* at 620, 86 S.Ct. 1018 (citation omitted).

Power Dekor argues on appeal that the Commission's decision regarding validity is not supported by substantial evidence. According to Power Dekor, the disclosure of the original #044 application does not convey with reasonable clarity to those skilled in the art that the inventor possessed the invention —i.e., the concept of clearances—later claimed in claims 5 and 17 of the # 779 patent. Power Dekor contends that the later-claimed concept of "clearances" was not discussed in the original specification; rather, it was introduced as new matter in the application leading to the #779 patent through alterations to fourteen paragraphs, the introduction of new reference numbers in certain figures, and the addition of two completely new paragraphs.

Power Dekor contends that the Commission was incorrect in concluding that the patentee merely introduced the word "clearances" as a generic term that encompasses (1) the "recesses," (2) the "chambers/dust chambers," and (3) the "spaces/intermediate spaces" that were disclosed in the original disclosure. Power Dekor argues that those three terms were used in the original disclosure to describe three different types of spaces, and that nothing in the original disclosure indicates to one of ordinary skill that "recesses," "chambers/dust chambers," and "spaces/intermediate spaces" can be treated the same. Indeed, Power Dekor notes, the original disclosure provides that "chambers/dust chambers" and "spaces/intermediate spaces" are internal voids that are formed when two panels are coupled together, whereas it only describes certain areas of uncoupled panels as "recesses." According to Power Dekor, this inconsistency is manifested in the conflicting ways that the term "clearance" is used in the claims of the #779 patent, wherein "clearance" is used in claim 1 to refer to the internal void between to adjacent panels but in claim 13 to refer to an edge that *defines* the internal void upon coupling of two adjacent panels.

Finally, Power Dekor argues that claims 5 and 17 of the #779 patent do not simply require the general presence of one or more "clearances." Rather, they require a specific combination of clearances in specific locations between adjacent floor panels. According to Power ***1336** Dekor, the original disclosure does not describe the importance of including clearances in the specific combinations claimed in claims 5 and 17 of the #779 patent. In support of this argument, Power Dekor cites our decision in *Purdue Pharma.* The claims at issue there were directed at a method of treating pain by orally administering a sustained-release dosage of an opioid analgesic on a once-a-day basis, wherein the maximum plasma concentration (C_{max}) achieved was more than twice the plasma level of the opioid at approximately 24 hours after administration (C_{24}). *Purdue Pharma,* 230 F.3d at 1322–23. We acknowledged that certain examples in the original specification "provide[d] date from which one can piece together the [later-claimed] C_{max}/C_{24} ratio." *Id.* at 1326. However, we determined that the ratio was not supported by the original specification because "neither the text accompanying the examples, nor the data, nor anything else in the specification in any way emphasizes the C_{max}/C_{24} ratio," and thus, we concluded that "one of ordinary skill in the art would not be directed to the C_{max}/C_{24} ratio as an aspect of the invention." *Id.* Power Dekor argues that, as in *Purdue Pharma,* it is not enough here for the original disclosure to simply show internal voids existing in various figures. It must have made clear that the inventor was in possession of the specifically claimed combination of those voids, which it did not.

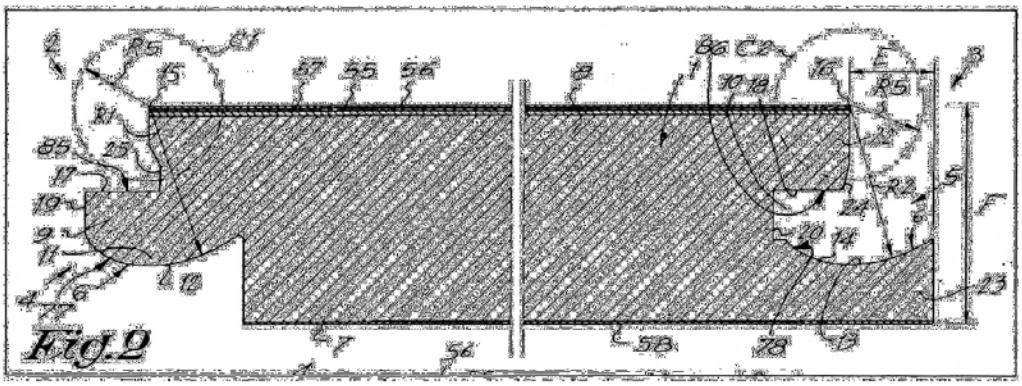
The Commission and Unilin respond that the Commission's conclusion regarding validity of the clearance claims is supported by substantial evidence. They argue that the #779 patent's claims cover the very internal voids that were shown and described in the original disclosure. In addition, they contend that merely adding the generic word "clearance" to describe those spaces did not constitute new matter. Finally, Unilin and the Commission argue that there is nothing improper about using the term "clearance" in two different ways within the #779 patent—in one way to describe the

"recess" of an uncoupled panel and in another to describe different voids formed between two coupled panels.

We agree with the Commission and Unilin that the Commission's conclusion regarding validity of the clearance claims is supported by substantial evidence. The internal voids recited in claims 5 and 17 of the #779 patent are all shown and described in the disclosure accompanying the original #044 application. Claim 5 requires a "plurality of separate clearances adjacent at least a portion of said outer peripheral portion of said tongue between said groove and said tongue." The ALJ's interpretation of the term "clearance" in claim 5—not contested here—was "an open space between two coupled panels, one panel containing a tongue, and one panel containing a groove, that is not created by normal machining tolerances." *ALJ Determination* at 72. Such "open spaces" are depicted in at least Figures 7 and 23 of the original disclosure. The spaces were originally described as "dust chambers **81,**" #486 patent col. 11 l.66–col. 12 l.4, whereas the #779 patent application was amended to refer to the spaces as "dust chambers *or clearances* **81,**" #779 patent col.12 ll.40–46 (addition emphasized). In both cases, the spaces were described as having "the advantage that inclusions which get between the floor panels ... during the engagement do not exert an adverse influence upon good engagement." #779 patent col. 12 ll.40–46; #486 patent col. 11 l.66–col. 12 l.4.

As noted by the ALJ, the term "clearance" is used somewhat differently in claim 17 of the #779 patent, referring not to a chamber itself but to an area of an uncoupled panel that defines a chamber upon coupling. Claim 17 of the #779 patent requires a "first clearance below said upper side of said panel and defining an ***1337** upper lip contact surface adjacent said clearance, said first clearance defining an upper chamber below said upper side and above said tongue upon coupling of cooperating coupling parts." The ALJ's interpretation of the term "clearance" in claim 17—also not contested here—was "an indentation, of either the tongue panel or groove panel of an uncoupled joint, that is not created through normal machining tolerances." *ALJ Determination* at 72. Said "indentation" is shown and labeled in the figures of the original disclosure representing uncoupled floor panels—e.g., Figures 2 and 5. The original disclosure referred to the indentation of Figure 2 as a "recess **25,**" #486 patent col.6 ll.30–35, whereas the #779 patent application was amended to refer to the same indentation as a "recess *or clearance* **25,**" #779 patent col.6 ll.34–39 (addition emphasized). The description accompanying the indentation of Figure 5 was similarly amended from "recess" in the original disclosure, #486 patent col.7 ll.10–11, to "recess or clearance" in the #779 patent, #779 patent col.7 ll.19–21. Figure 2, with recess **25,** is shown below:

Fig. 2



Likewise, the upper chamber defined by the first clearance of claim 17 is shown and described in the original disclosure. The upper chamber is clearly shown in all of the original figures depicting coupled floor panels—i.e., Figures 4, 7, 8, 9, 10, and 23. Figure 4, included below, shows the upper chamber as the upper most open space between the adjacent floor panels. The upper chamber is also marked **81** on Figure 23 of the #779 patent above.

***1338 Fig. 4**

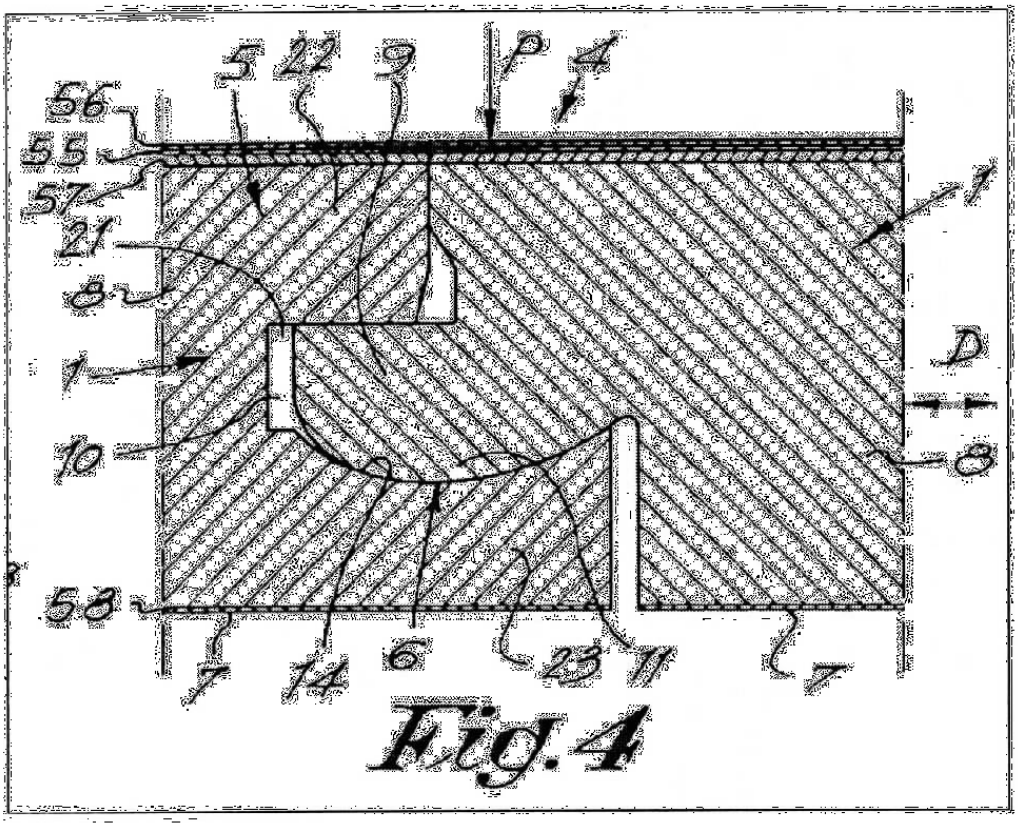


Fig. 4

In addition to an upper chamber defined by a first clearance, claim 17 requires "at least one second chamber being defined between the tongue and groove in the area along the tongue periphery between the respective upper tongue contact surface and the lower tongue contact surface when adjacent panels are coupled." The location of the "second chamber" recited in claim 17 is essentially the same as the location of the "plurality of separate clearances" recited in claim 5 (see, e.g., the middle open spaces marked **81** in Figure 23 above). Thus, in addition to an upper chamber defined by a first clearance, claim 17 requires at least one of the spaces recited in claim 5.

In light of the foregoing, we cannot say that the Commission's conclusion regarding the validity of claims 5 and 17 is unsupported by substantial evidence. That is, substantial evidence supports the Commission's determination that those claims were adequately described in the originally-filed disclosure. Like the Commission, we do not think that the patentee's various amendments to the specification—e.g., the introduction of the generic term "clearance" and addition of labels to certain figures—in prosecuting the #779 patent were of such significance as to demonstrate a prior lack of possession with respect to the subject matter claimed in claims 5 and 17.

Nor do we think that the patentee's attribution of two related meanings to the term "clearance" is problematic. It is the later-*claimed* subject matter that must be supported by adequate written description in the originally-filed disclosure. *See Vas–Cath,* 935 F.2d at 1564 ("The invention is, for purposes of the 'written description' inquiry, whatever is now claimed."). Here, there is no dispute with respect to the subject matter that is claimed in claims 5 and 17. Although Power Dekor refers to the patentee's use of the term "clearance" as "inconsistent," it does not argue that either claim 5 or claim 17 is indefinite. Indeed, the ALJ had no trouble correctly distinguishing, in context, between the patentee's use of the term "clearance" in claim 5 to describe an internal void in coupled panels, and in claim 17 to describe the indentation of an uncoupled panel that defines an internal void upon coupling. *See ALJ Determination* at 72; *see also Pitney Bowes, Inc. v. Hewlett–Packard Co.,* 182 F.3d 1298, 1311 (Fed.Cir.1999) (finding it appropriate, in the context of the patent at issue, to construe the same term to have two different meanings).

***1339** Finally, we are not persuaded to reverse the Commission's finding of validity by Power Dekor's citation to *Purdue Pharma.* That case was an appeal from a bench trial, wherein the district court held that the claims at

issue were *invalid* for lack of adequate written description under § 112 ¶ 1. Thus, the question we considered was whether the district court clearly erred in concluding that the claims at issue lacked adequate written description. *Purdue Pharma,* 230 F.3d at 1323–24. Under the clear error standard, a court's findings will not be overturned in the absence of a "definite and firm conviction" that a mistake has been made. *Hoffmann–La Roche, Inc. v. Promega Corp.,* 323 F.3d 1354, 1359 (Fed.Cir.2003) (citation omitted). We ultimately held that the district court's conclusion was not clearly erroneous. *Purdue Pharma,* 230 F.3d at 1323–24. Here, we review for substantial evidence the Commission's conclusion that the clearance claims were *not invalid* for lack of adequate written description. Moreover, the later-filed claims in *Purdue Pharma* were directed at a specific numerical relationship between two variables ($C_{max}/C24 > 2$). However, there was nothing in the disclosure suggesting that the C_{max}/C_{24} ratio itself—regardless of the specifically claimed range of values for that ratio—was an important feature of the invention. *Id.* at 1326–27. Indeed, we found that the disclosure did not even motivate one to calculate C_{max}/C_{24}. *Id.* at 1327. Here, the importance of the later-claimed chambers was clearly described in the originally-filed disclosure. *See* #486 patent col.6 ll. 14–17, col.7 ll.46–49, col. 11 l.66–col. 12 l.4. We are not persuaded by *Purdue Pharma* that the Commission's decision regarding validity of the clearance claims in this case is unsupported by substantial evidence.

CONCLUSION

For the foregoing reasons, we affirm the Commission's determination that claims 5 and 17 of the #779 patent are valid. We decline to reach as moot the Commission's determinations with respect to infringement of claims 1 and 2 of the #836 patent and claims 3 and 4 of the #292 patent.

AFFIRMED

COSTS

No costs.

Parallel Citations

30 ITRD 2201, 87 U.S.P.Q.2d 1590

Footnotes

1 After oral argument, Power Dekor Group withdrew from the appeal. However, because the parties referred to appellants collectively as "Power Dekor" in their respective briefs and at oral argument, we do so here.

2 The Commission concluded that all seven of appellants' products subject to investigation infringed various claims of Unilin's patents: five products imported by Jiangsu Lodgi Wood Industry Co. and two products imported by Yingbin–Nature (Guangdong) Wood Industry Co. Ltd.

3 Compare the rotational assembly method depicted in Figures 3 and 4 of the #836 patent, *see* #836 patent col.5 ll.52–56 ("In the form of embodiment of FIGS. 2 to 4, ... two floor panels [are] mutually engaged by means of a turning movement, without the occurrence of any snap-together effect."), with the "snap action" assembly method depicted in Figures 6 and 7, *see id.* col.7 ll.1–6 ("The locking elements [depicted in Figures 6 and 7] ... can easily be pushed over each other until they grip behind each other by means of a snap-together effect....").

4 The Commission's determination with respect to Power Dekor's infringement of the lower lip claims will have no effect in future import proceedings concerning Power Dekor. When a Court of Appeals decides a case without reaching a particular issue, the resolution of that issue by the trial court does not give rise to collateral estoppel. *See, e.g., Salovaara v. Eckert,* 222 F.3d 19, 33–34 n. 10 (2d Cir.2000) (denying application of collateral estoppel because "it cannot be said that 'the issue in question was actually and necessarily decided' in the prior appeal." (quoting *Hachamovitch v. DeBuono,* 159 F.3d 687, 695 (2d Cir.1998))); *Hicks v. Quaker Oats Co.,* 662 F.2d 1158, 1168 (5th Cir.1981) ("[T]he general rule is that if a judgment is appealed, collateral estoppel only works as to those issues specifically passed upon by the appellate court."); *see also* 18 Charles Alan Wright, Arthur R. Miller & Edward H. Cooper, *Federal Practice and Procedure* § 4421 (2d ed. 2002) ("The federal decisions agree with the Restatement view that once an appellate court has affirmed on one ground and passed over another, preclusion does not attach to the ground omitted from its decision."); Restatement (Second) of Judgments § 27 cmt.o (1982) ("If the judgment of the court of first instance was based on a determination of two issues ... [and] the appellate court upholds one of these determinations as sufficient and refuses to consider [the second,]" there is no preclusive effect as to the second issue.). Of course, that is not a *reason* to hold infringement of the lower lip claims unappealable, but it certainly is a *result* of our holding.

30 ITRD 2201, 87 U.S.P.Q.2d 1590

End of Document

EXHIBIT C

US006874292B2

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

(10) **Patent No.: US 6,874,292 B2**
(45) **Date of Patent: Apr. 5, 2005**

(54) **FLOOR PANELS WITH EDGE CONNECTORS**

(75) Inventors: **Stefan Simon Gustaaf Moriau**, Gent (BE); **Mark Gaston Maurits Cappelle**, Staden (BE); **Bernard Paul Joseph Thiers**, Oostrozebeke (BE)

(73) Assignee: **Unilin Beheer BV, Besloten Vennootschap**, Ijssel (NL)

(*) 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.: **10/266,667**

(22) Filed: **Oct. 9, 2002**

(65) **Prior Publication Data**

US 2003/0024201 A1 Feb. 6, 2003

Related U.S. Application Data

(63) Continuation of application No. 09/471,014, filed on Dec. 23, 1999, now Pat. No. 6,490,836, which is a continuation of application No. 08/872,044, filed on Jun. 10, 1997, now Pat. No. 6,006,486.

(30) **Foreign Application Priority Data**

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Apr. 15, 1997 (BE) 9700344

(51) **Int. Cl.**[7] **E04B 2/08**

(52) **U.S. Cl.** **52/590.2**; 52/586.1; 52/589.1; 52/592.1; 52/592.3

(58) **Field of Search** 52/586.1, 589.1, 52/592.1, 592.3

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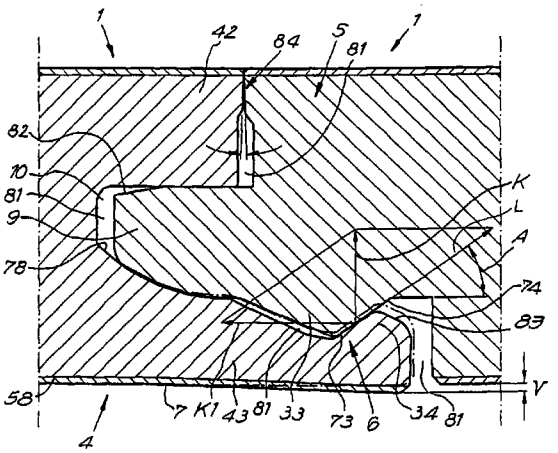
(57) **ABSTRACT**

Floor covering, including hard floor panels which, at least at the edges of two opposite sides, are provided with coupling parts, cooperating which each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges and parallel to the underside of the coupled floor panels, and provide a snap-action coupling.

6 Claims, 10 Drawing Sheets



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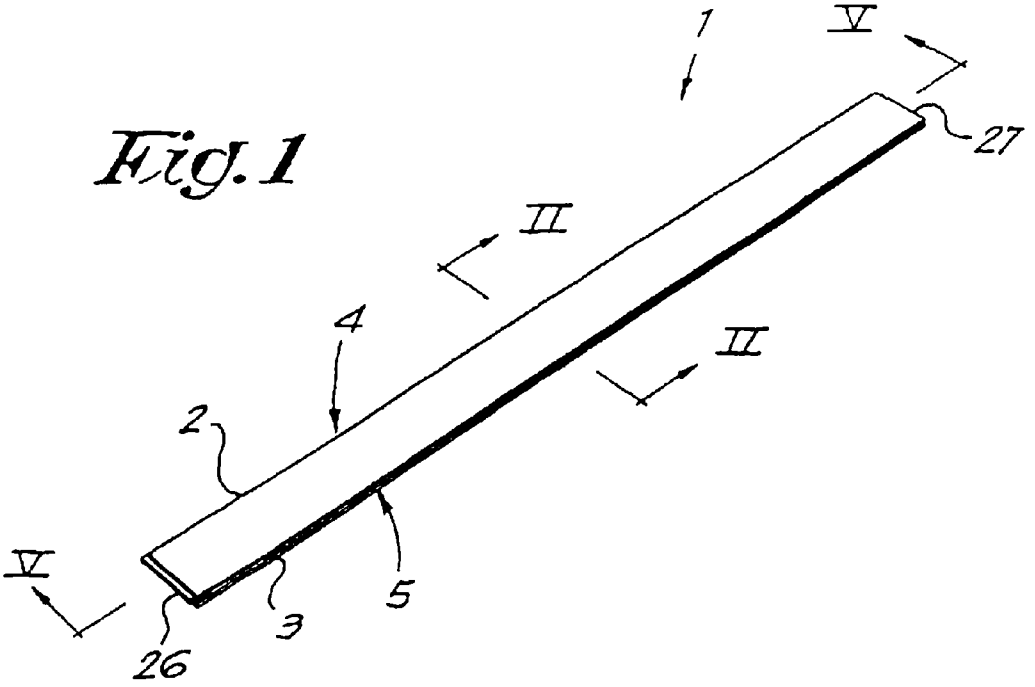
1
V
27
II
4
II
2
V
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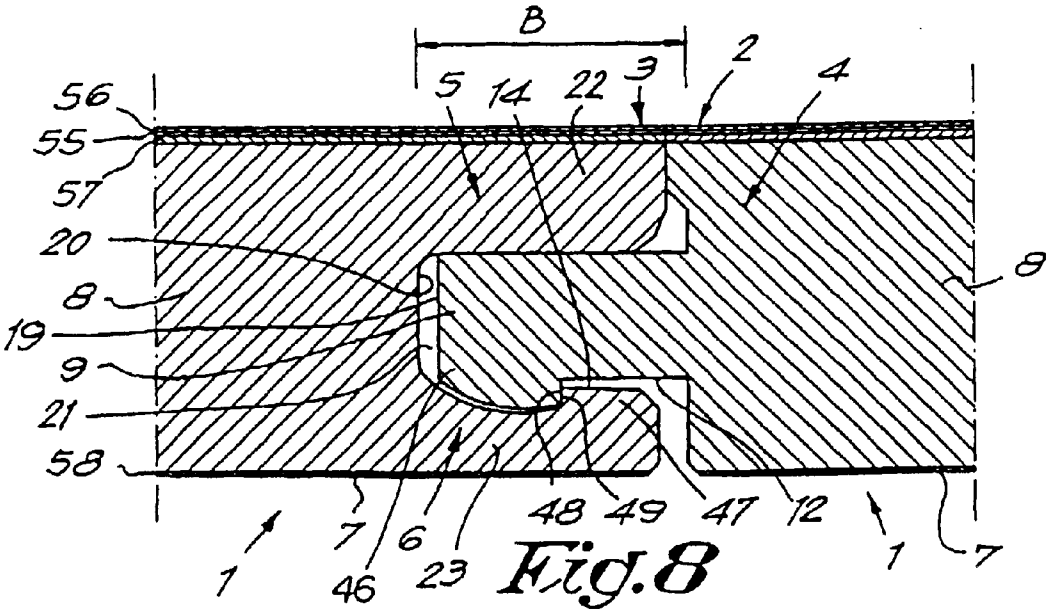
26

Fig. 1


B
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3
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23
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Fig. 8

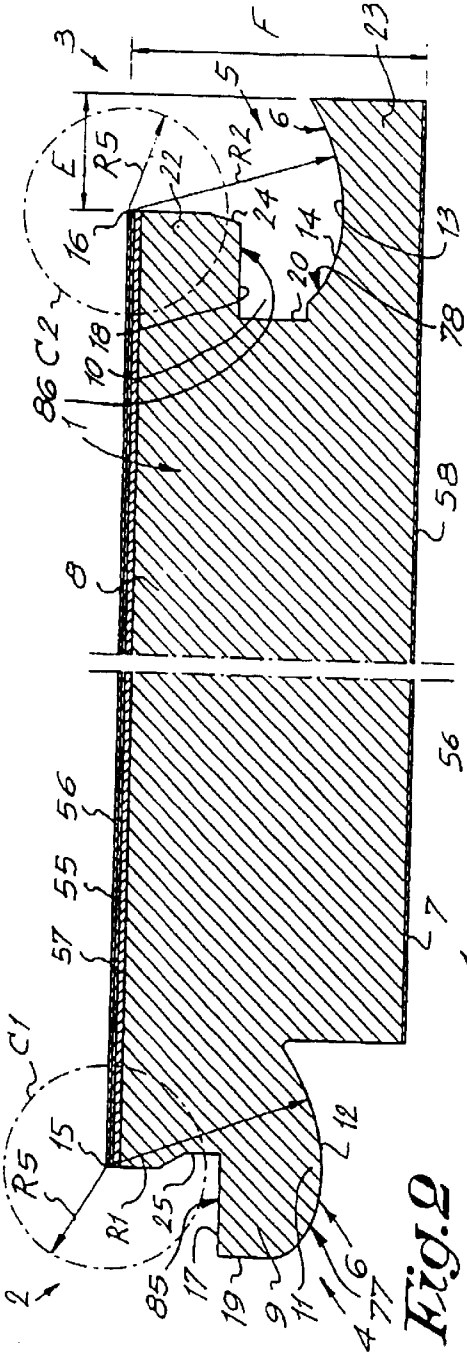


Fig. 2

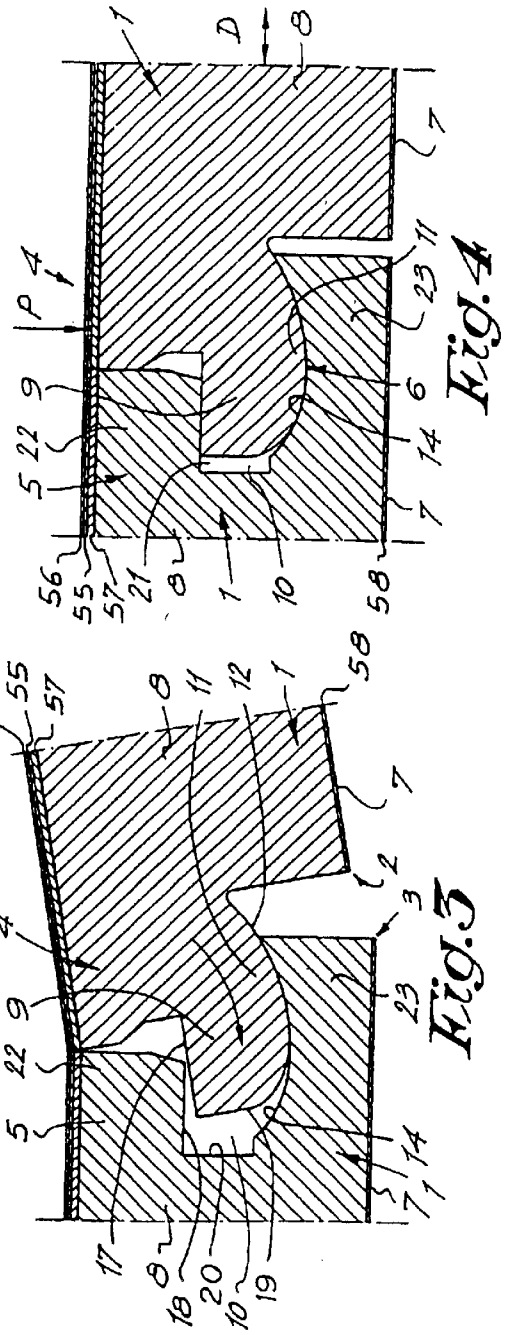


Fig. 3

Fig. 4

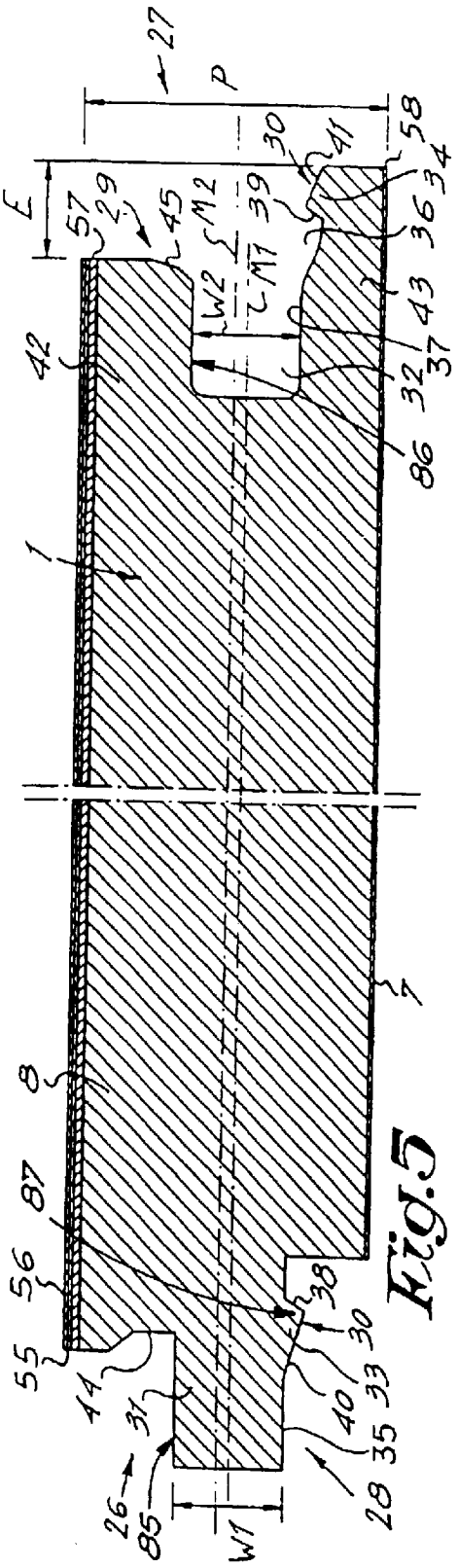


Fig.5

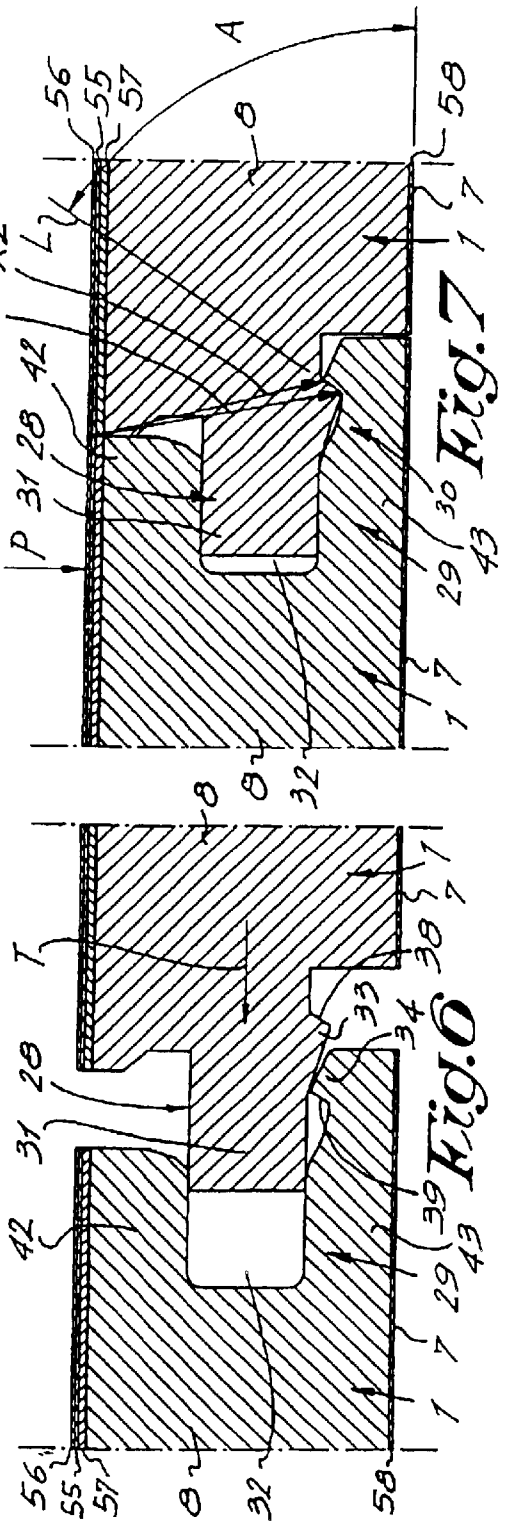


Fig.7

Fig.6

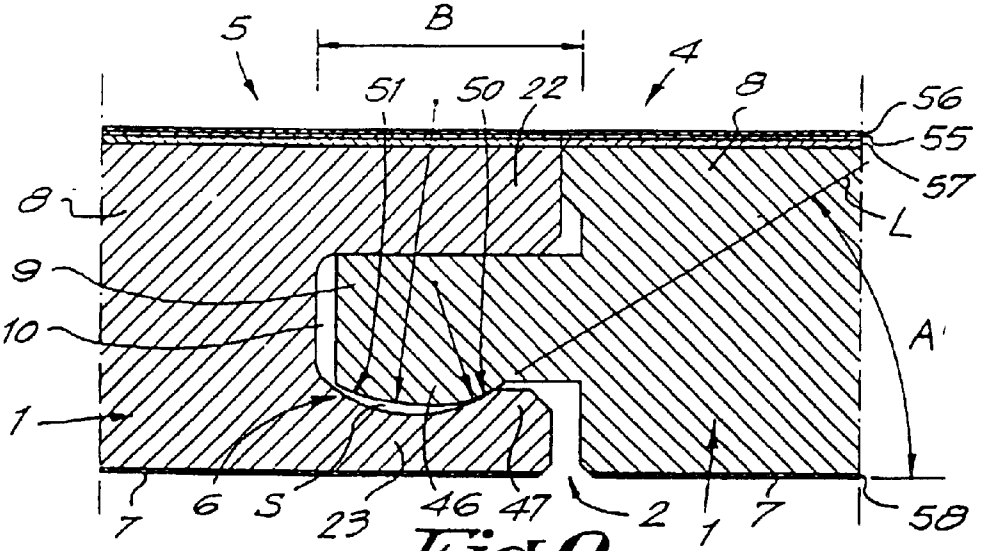


Fig.9

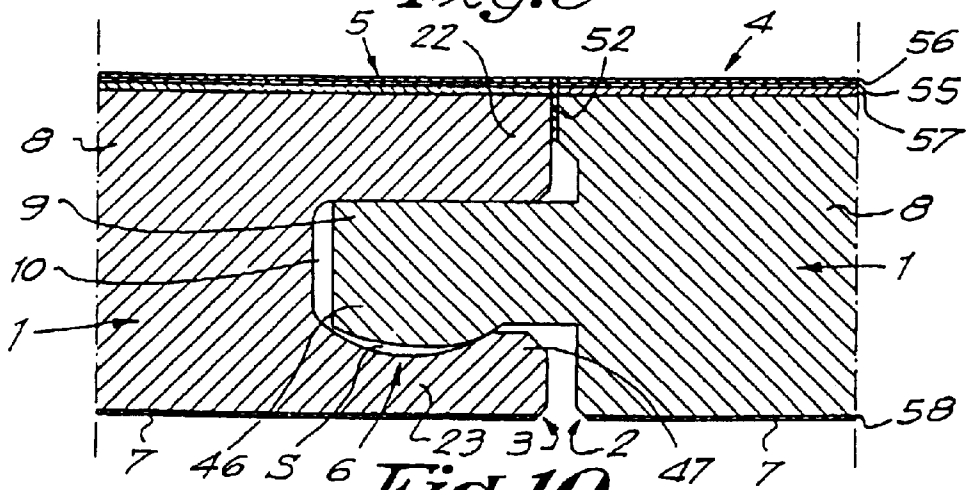


Fig.10

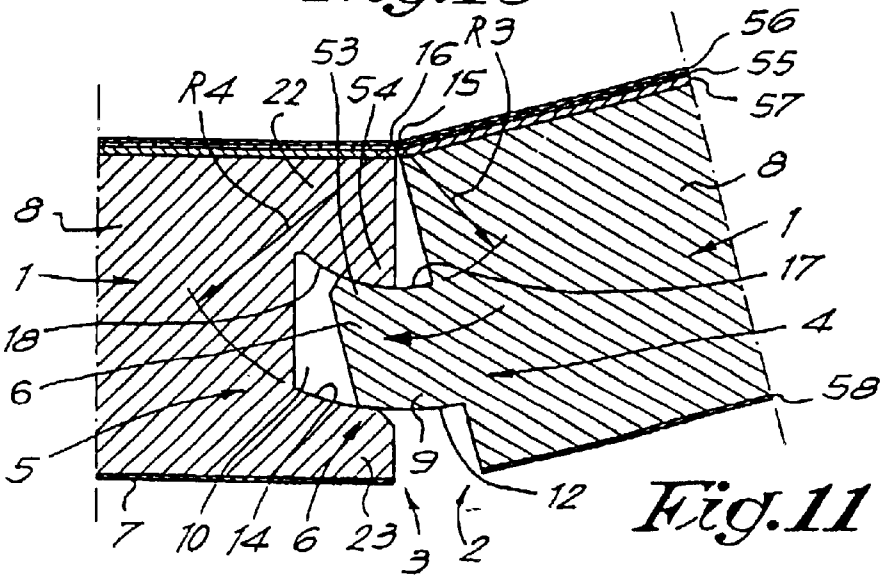
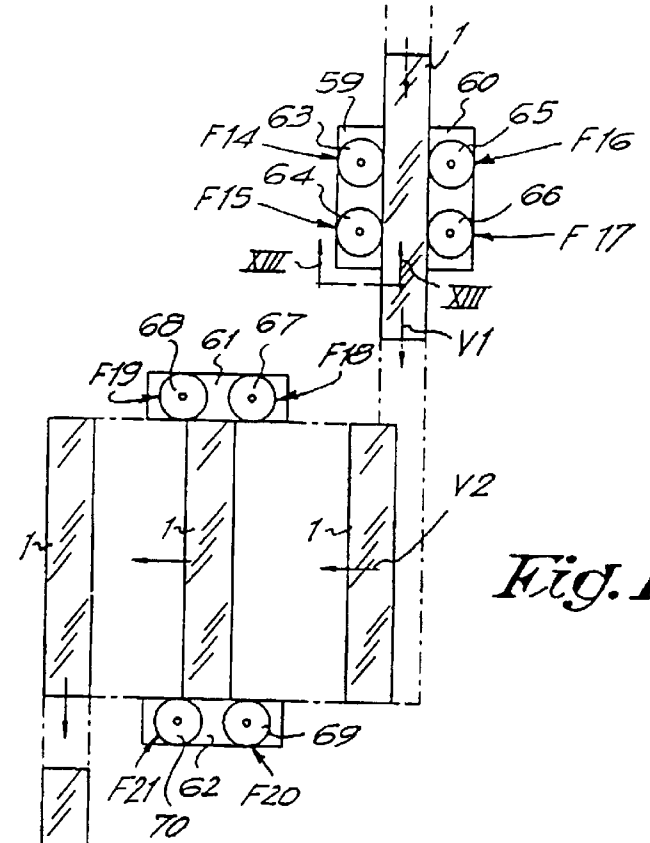


Fig.11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60
63
65
F14
F16
64
F15
66
F17
XIII
XIII
V1
68
61
67
F19
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V2
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1
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69
F21
62
F20
70
1

Fig. 12

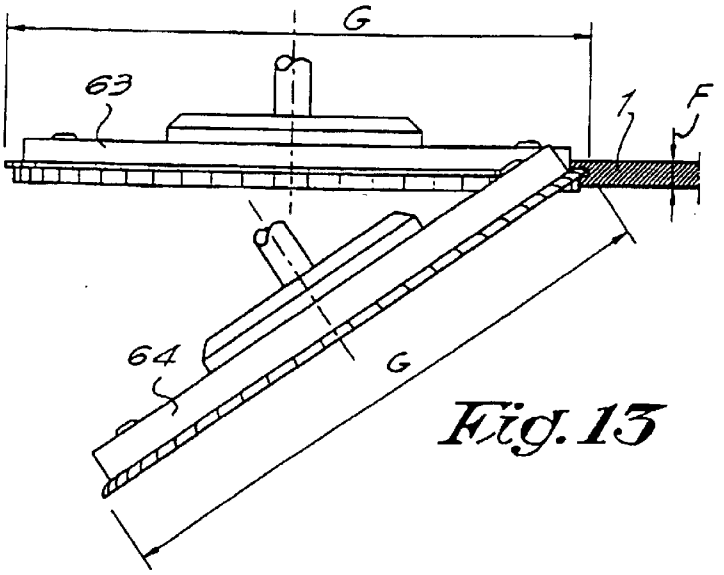

G
63
1
F
64
G

Fig. 13

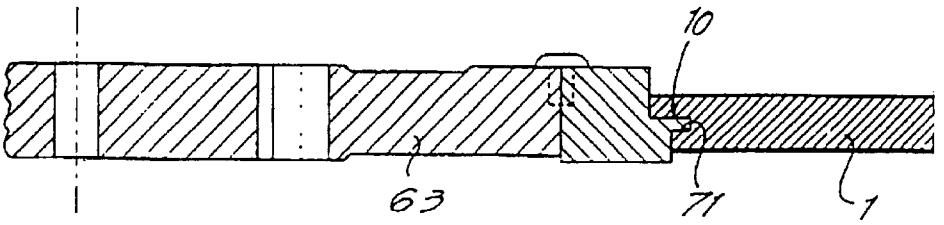


Fig. 14

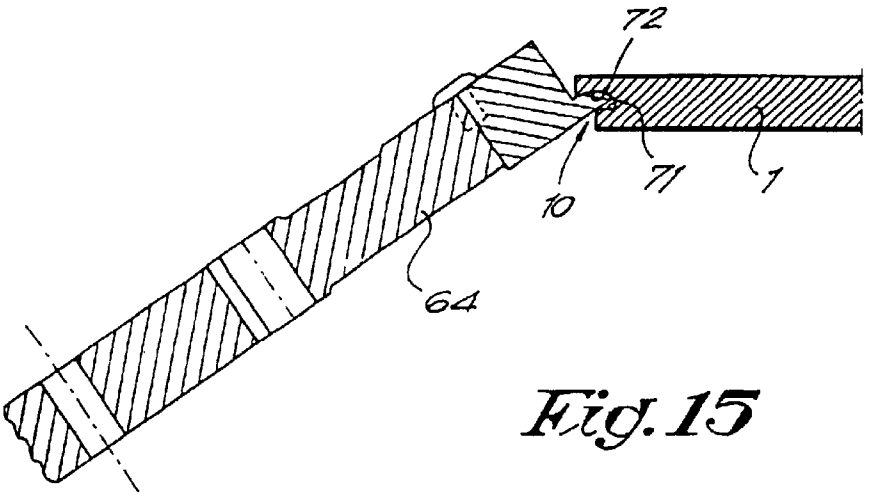


Fig. 15

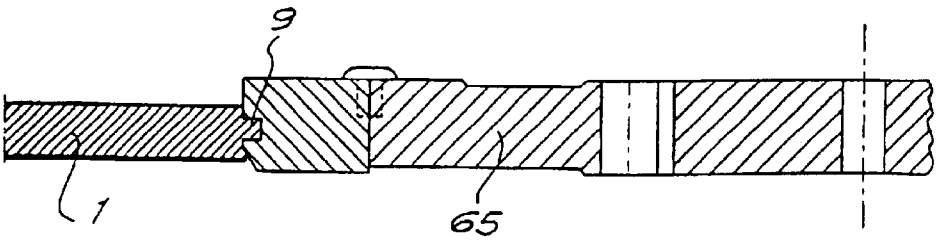


Fig. 16

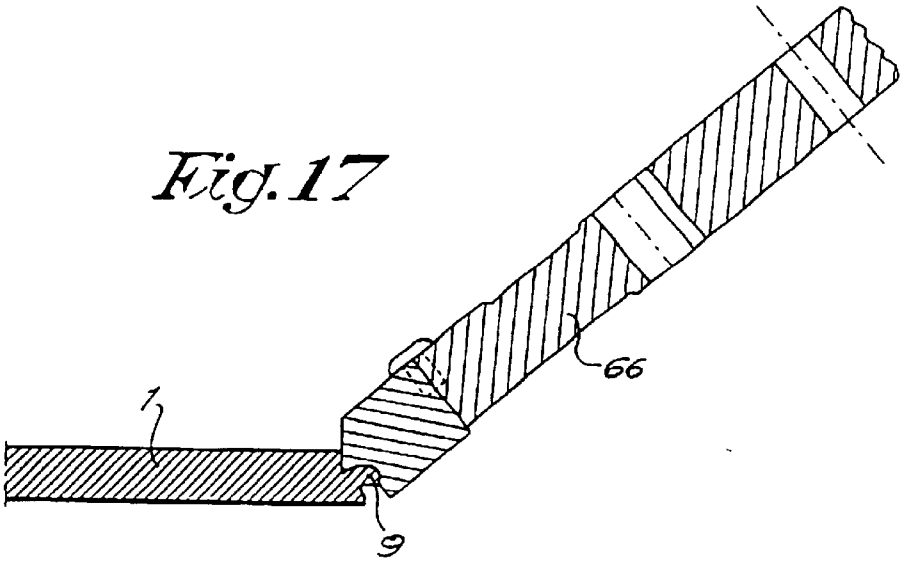


Fig. 17

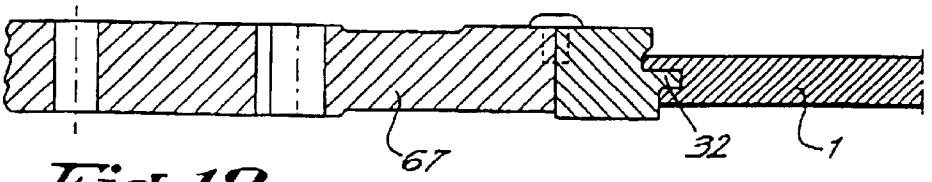


Fig. 18

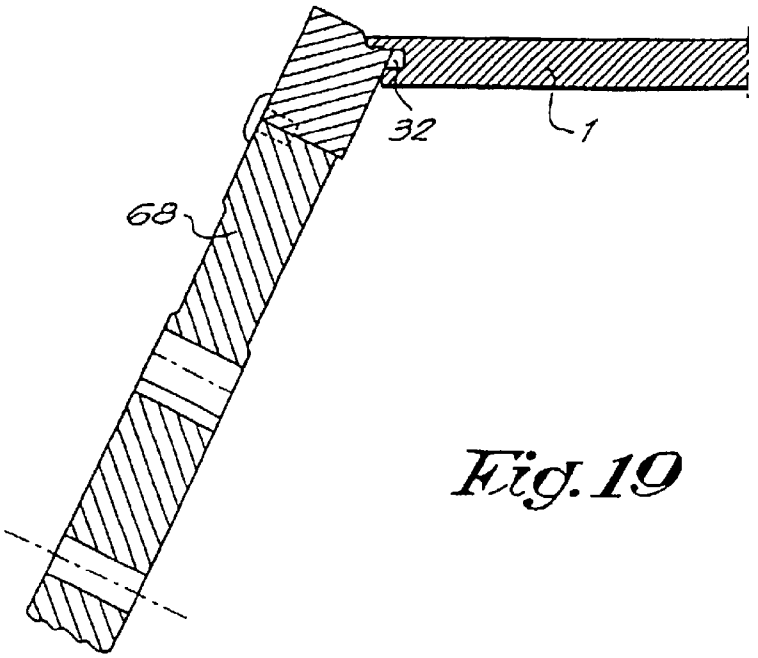


Fig. 19

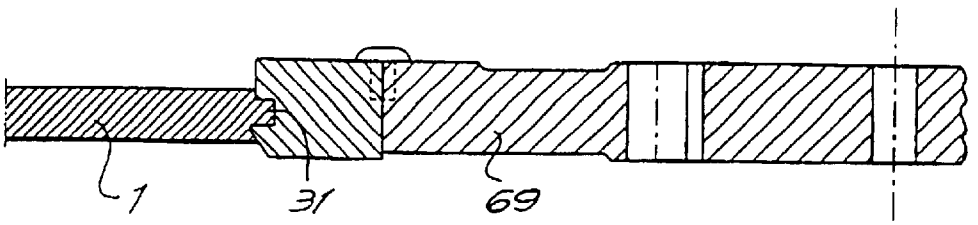


Fig. 20

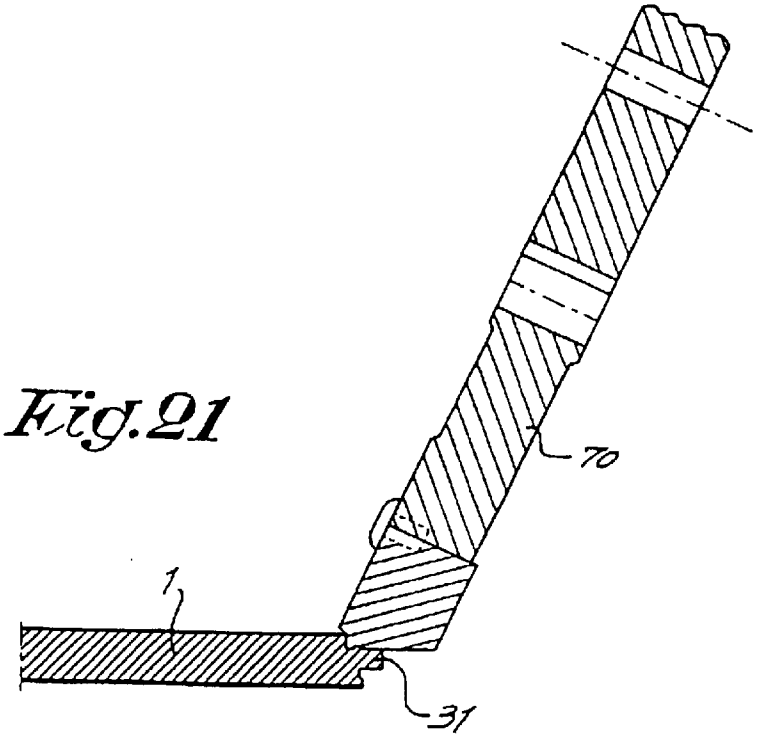
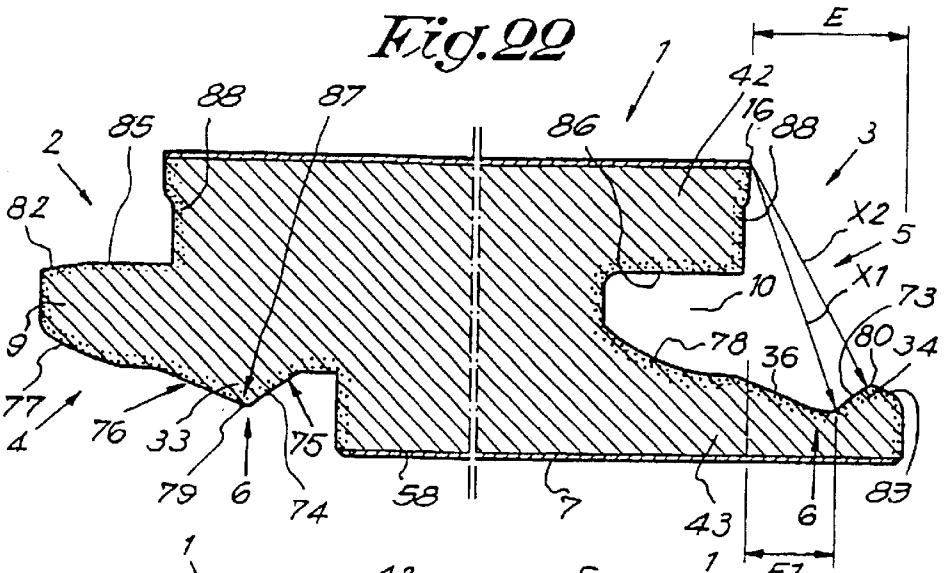


Fig. 21

Fig.22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2
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88
87
86
82
X2
5
X1
73
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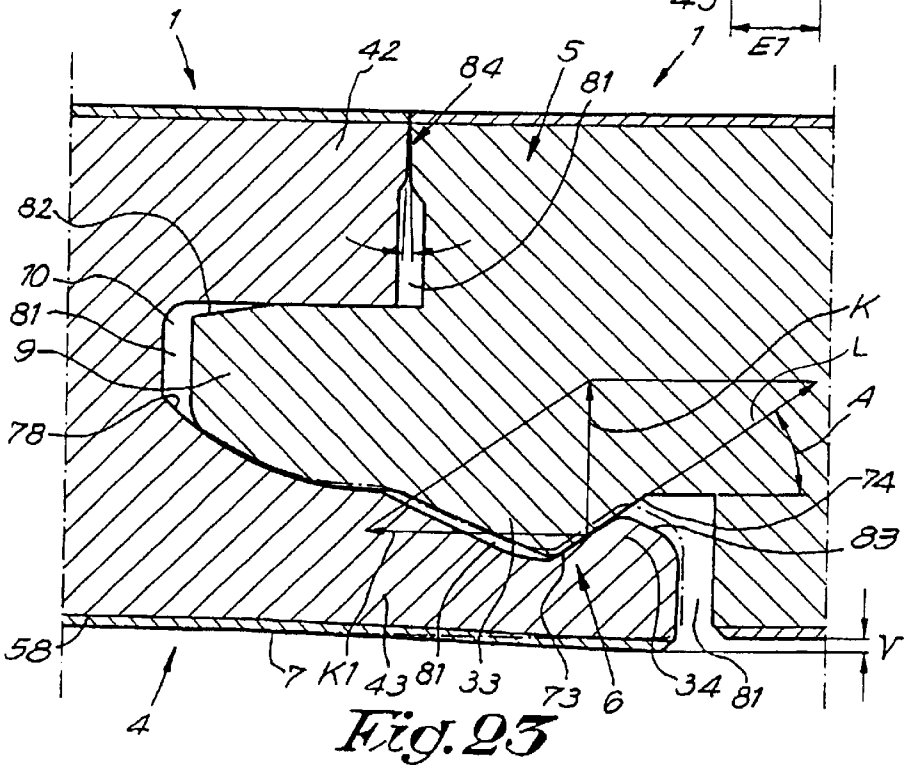
83
E1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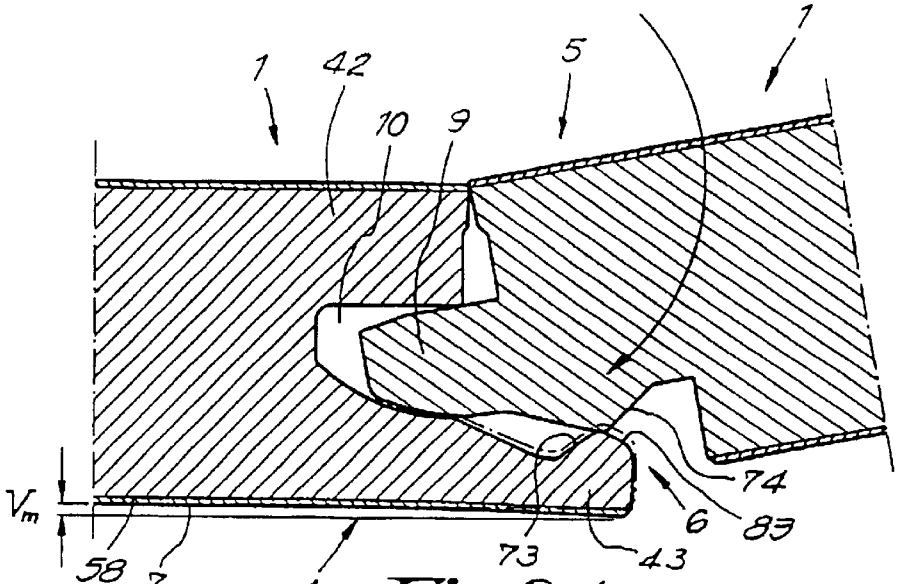
34
81
V

Fig.23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5
1
10
9
74
6
83
V_m
58
7
4
73
43

Fig.24

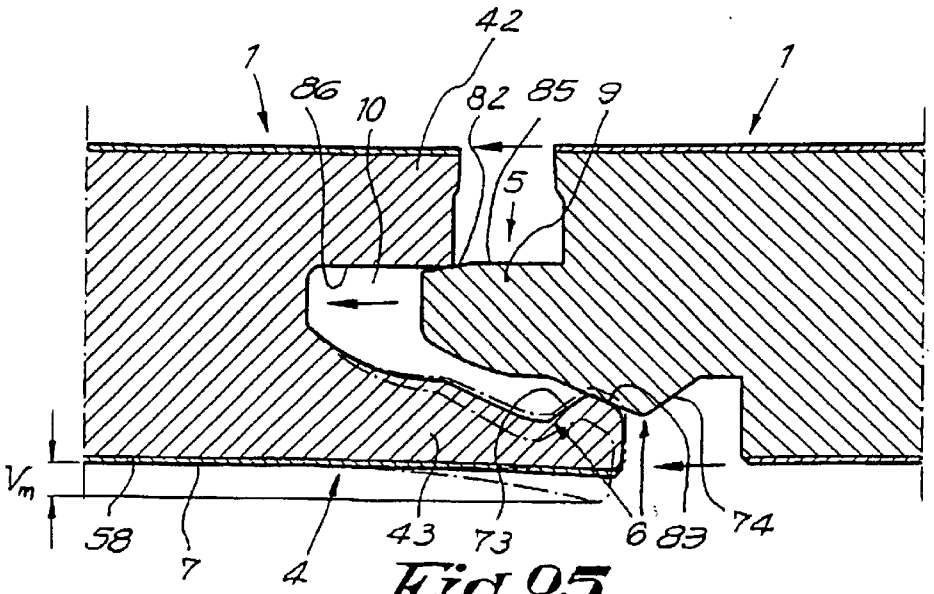
42
1
86
10
82
85
9
1
5
V_m
58
7
4
43
73
6
83
74

Fig.25

FLOOR PANELS WITH EDGE CONNECTORS

RELATED APPLICATION DATA

This application is a continuation of U.S. patent application Ser. No. 09/471,014, filed Dec. 23, 1999, now U.S. Pat. No. 6,490,836; which is a continuation of application Ser. No. 08/872,044 filed Jun. 10, 1997, now U.S. Pat. No. 6,006,486.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a floor covering made of hard floor panels.

2. Related Technology

In the first instance, the invention is intended for so-called laminated floors, but generally it can also be applied for other kinds of floor covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring.

It is known that such floor panels can be applied in various ways.

According to a first possibility, the floor panels are attached at the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels.

According to a second possibility, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena.

A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks.

In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation.

Examples of embodiments which apply such metal connection elements are described, among others, in the documents WO 94/26999 and WO 93/13280.

Furthermore, couplings are known which allow coupling parts to snap fit into each other, e.g., from the documents WO 94/1628, WO 96/27719 and WO 96/27721. The snapping-together effect obtained with these forms of embodiment, however, does not guarantee a 100-percent optimum counteraction against the development of gaps between the floor panels, more particularly, because in fact well-defined plays have to be provided in order to be sure that the snapping-together is possible.

From GB 424.057, a coupling for parquetry parts is known which, in consideration of the nature of the coupling, only is appropriate for massive wooden parquetry.

Furthermore, there are also couplings for panels known from the documents GB 2.117.813, GB 2,256.023 and DE 3.544.845. These couplings, however, are not appropriate for connecting floor panels.

BRIEF SUMMARY OF THE INVENTION

The invention aims at an improved floor covering of the aforementioned type, the floor panels of which can be coupled to each other in an optimum manner and/or the floor panels of which can be manufactured in a smooth manner, and whereby preferably one or more of the aforementioned disadvantages are excluded.

The invention also aims at a floor covering which has the advantage that no mistakes during installing, such as gaps and such, can be created.

Furthermore, the invention also aims at a floor covering whereby the subsequent development of gaps is excluded or at least counteracted in an optimum manner, whereby also the possibility of the penetration of dirt and humidity is minimalized.

To this aim, the invention relates to a floor covering, consisting of hard floor panels which, at least at the edges of the two opposite sides, are provided with coupling parts, cooperating which each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels into a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels. Hereby, these coupling parts are optimalized in such a manner that they allow that any form of play is counteracted and preferably is excluded.

By integrated mechanical locking elements is understood that these form a fixed part of the floor panels, either by being connected in a fixed manner to the floor panels, or by being formed in one piece therewith.

In a first important preferred form of embodiment, the coupling parts are provided with locking elements which, in the engaged position of two or more of such floor panels, exert a tension force upon each other which force the floor panels towards each other. As a result of this that not only the formation of gaps counteracted during installation, but also in a later stage the development of gaps, from any causes whatsoever, is counteracted.

According to another characteristic of the intention, the coupling parts, hereby are formed in one piece with the core of the floor panels.

According to a second important preferred embodiment, the aforementioned optimalization is achieved in that the floor covering panel possesses the following combination of characteristics: the coupling parts and locking elements are formed in one piece with the core of the floor panels; the coupling parts have such a shape that two subsequent floor panels can be engaged into each other exclusively by snapping together and/or turning, whereby each subsequent floor panel can be inserted laterally into the previous; the coupling parts are interlocked free from play in all directions in a plane extending perpendicular to the aforementioned edges; the possible difference between the upper and lower lip of the lips which border the aforementioned grooves, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than one time the total of the thickness of the panel; the total thickness of each related floor panel is larger than or equal to 5 mm; and that the basic material of the floor panels, of which the aforementioned core and locking elements are

formed, consists of a ground product which, by means of a binding agent or by means of melting together, is made into a unitary composite, and/or of a product on the basis of synthetic material and/or of a chip board with fine chips.

Due to the fact that the coupling parts provide for an interlocking free from play, as well as due to the fact that these coupling parts are manufactured in one piece, from the basic material of the floor panels, a perfect connection between adjacent floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of characteristics can be combined or not with the aforementioned characteristic that the locking elements exert a tension force upon each other when panels are joined together.

According to a third important preferred embodiment, the characteristics of which may or may not be combined with the characteristics of the embodiments described above, the floor covering is characterized in that the lower lip which limits or defines the lower side of the groove, extends beyond the upper lip in the plane of the panel; the locking elements are formed at least of a contact portion which inwardly slopes downward; and that this portion, at least partially, is located in the portion of the lower lip which extends beyond the upper lip. The advantages of these features will appear from the further description.

According to a preferred form of embodiment, the floor panels are configured as elongated panels and the coupling parts described above are applied along the longitudinal sides of these panels.

According to a particular form of embodiment, coupling parts are provided at the other two sides, too, either of another construction than described above or not.

In the most preferred form of embodiment, for the basic material use shall be made of the aforementioned product, which, as said, is ground and, by means of a binding agent, made into a unitary composite material. More particularly, for the core use shall be made of finely-ground wood which preferably is glued, more particularly, moisture resistant glued. Still more particularly, for the core use shall be made of so-called HDF board (High Density Fibreboard) or MDF board (Medium Density Fibreboard) which is highly compressed ground wood particles (fibers) and binder material. Hereinafter, the wood component of the core material shall be referred to as "wood product".

The fact that the invention is applied to floor panels the basic material of which consists of the material described above, offers the advantage that with the processing of this material, very smooth surfaces are obtained whereby very precise couplings can be realized, which, in first instance, is important in the case of a snap-together connection and/or turning connection free from play. Also, very special forms of coupling parts can be manufactured in a very simple manner because the aforementioned kinds of material can be processed particularly easy.

The surfaces obtained with HDF and MDF also have the advantage that the floor panels mutually can be shifted readily alongside each other in interlocked condition, even when engaged with a tensioning force.

The applicants also discovered that the aforementioned materials, in particular HDF and MDF, show ideal features in order to realize a connection, such as mentioned above, as these material show the right features in respect to elastic deformation in order to, on the one hand, realize a snap-together effect, and, on the other hand, receive expansion and shrinkage forces in an elastic manner, whereby it is avoided that the floor panels come unlocked or are damaged in an irreparable manner.

In the case that for the core use is made of a material based on synthetic material, to this end solid synthetic material can be used as well as a mixture of synthetic materials, eventually composed of recycled materials.

The floor covering preferably is formed by joining the floor panels into each other free of glue. Hereby, the connections are of such nature that the floor panels can be disassembled without being damaged, such that, for example, when moving from one residence or location to another, they can be taken along in order to be placed down again. It is, however, clear that a glueing between tongue and groove is not excluded.

The invention, of course, also relates to floor panels which allow the realization of the aforementioned floor covering.

The invention also relates to a method for the manufacturing of the aforementioned floor panels with which the advantage that the tongues and/or grooves, including the corresponding locking means, can be provided at the floor panels at high production speeds without problems. More particularly, it aims at a method which allows that the rather complicated forms of the tongue and the groove of the aforementioned floor panels can be formed completely by means of milling cutters, the diameter of which can be chosen independent of the form to be realized, such that the use of small milling cutters, for example finger cutters, with diameters smaller than the depth of the tongue or groove can be excluded.

In accordance with this method the tongue and/or groove is formed by means of a milling process using at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in respect to the related floor panel. During each of the aforementioned milling cycles, preferably substantially the final form of one flank, either of the tongue or of the groove, is formed.

For the aforementioned two milling cycles, thus, milling cutters are used which extend outside the groove, respectively the tongue. More particularly the diameters of these milling cutters shall at least be 5 times and even better 20 times larger than the thickness of the floor panels.

The use of milling cutters having the aforementioned diameters has as an advantage that the normal production speeds can be maintained which are also applied during milling of a classical straight tongue and groove. There is also the advantage obtained that the installation of such milling cutters induce only minor or no additional costs because such milling cutters can be placed directly upon a motor shaft and/or the conventional machines can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

With the intention of better showing the characteristics according to the invention, in the following, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

FIG. **1** represents a floor panel of a floor covering according to the invention;

FIG. **2**, on a larger scale, represents a cross-section according to line II—II in FIG. **1**;

FIGS. **3** and **4** represent how two floor panels with coupling parts according to FIG. **2** match into each other;

FIG. **5**, on a larger scale, represents a cross-section according to line V—V in FIG. **1**;

FIGS. **6** and **7** represent how two floor panels with coupling parts according to FIG. **5** match into each other;

FIGS. **8** to **11** represent a number of variants of coupling parts of floor panels according to the invention;

FIG. **12** schematically represents how the floor parts can be provided with coupling parts;

FIG. **13** represents a cross-section according to line XIII—XIII in FIG. **12**;

FIGS. **14** to **21**, on a larger scale and in cross-section, represent the penetration of the milling cutters which are indicated in FIG. **12** with arrows F**14** to F**21**;

FIG. **22** represents a floor panel according to the invention;

FIG. **23**, on a larger scale, represents the coupling of two floor panels of FIG. **22**;

FIGS. **24** and **25** represent two manners of coupling floor panels according to FIG. **22** to each other.

DETAILED DESCRIPTION

The invention relates to a floor covering which is composed of hard floor panels **1**, for example, such as a laminated panel as shown in FIG. **1**.

These floor panels **1** can be of various shape, for example, rectangular or square, or of any other shape.

In the most preferred form of embodiment, they shall be manufactured in an elongated form, such as shown in FIG. **1**, for example, with a length of 1 to 2 meters. The thickness, however, can also vary, but is preferably 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel **1** is, at least at the edges of two opposite sides **2**–**3**, provided with coupling parts **4**–**5** which permit two adjacent identical floor panels **1** to be coupled to each other.

According to the invention, the coupling parts **4**–**5**, as represented in the FIGS. **2** to **4**, are provided with integrated mechanical locking parts or locking elements **6** which prevent the drifting or sliding apart of two coupled floor panels **1** in a direction D perpendicular to the respective sides **2**–**3** and parallel to the underside **7** of the coupled floor panels **1**; the coupling parts **4**–**5** and the locking elements **6** are formed in one piece with the core **8** of the floor panels **1**; the coupling parts **4**–**5** have such a shape that two subsequent floor panels **1** can be engaged into each other solely by snapping-together and/or turning after the coupling parts are partially engaged, whereby each subsequent floor panel **1** can be laterally inserted into the previous; and the coupling parts **4**–**5** preferably are interlocked free from play in all directions in a plane which is located perpendicular to the aforementioned edges.

In the case of floor panels **1** with an elongated shape, as represented in FIG. **1**, the respective coupling parts **4**–**5** are located at the longitudinal sides **2**–**3**.

The coupling parts **4**–**5** can be realized in various forms, although the basic forms thereof will always be formed by a tongue **9** and a groove **10**.

In the form of embodiment of FIGS. **2** to **4**, the related floor panel **1** is provided with coupling parts **4**–**5** and locking means or locking elements **6** which allow two floor panels **1** to be mutually engaged by means of a turning movement, without the occurrence of any snap-together effect.

In the represented example, the locking elements **6** consist of a first locking element **11**, formed by a protrusion with a bent round shape at the lower side **12** of the tongue **9**, and a second locking element **13** (shown in FIG. **2**), formed by a recess with a bent hollow or downwardly concave shape in the lower wall **14** of the groove **10**.

The locking elements **11**–**13** ensure that two floor panels **1** which are coupled to each other can not move laterally in the horizontal plane with respect to each other.

In order to enable two floor panels **1** to be inserted into each other by means of a turning movement, the curvatures preferably are circular. The bottom side **12** of locking means or locking elements **6** has a curvature with a radius R**1**, the center of which coincides with the respective upper edge **15** of the floor panel **1**, whereas the lower wall **14** of the locking part **5** has a curvature with a radius R**2** which is equal to the radius R**1**, but its center coincides with the respective upper edge **16**. Radii R**1** and R**2** may also be applied which are larger or smaller than the distance to the upper edge **15**, **16** respectively, and/or which differ from each other in size.

The upper side **17** of the tongue **9** and the upper wall or side **18** of the groove **10** are preferably flat and preferably are located in the horizontal plane.

The inner side **20** of the groove **10** and the front side **19** of the tongue **9** of the two interlocked floor panels **1** preferably do not fit closely against each other, such that an intermediate space **21** is created between them into which possible dust remainders or such can be pushed away by means of the tongue **9**.

The tongue **9** and the groove **10** preferably have shapes which are complementary to each other, such that the tongue **9** in the engaged condition of two identical floor panels **1** precisely sits against the upper wall **18** and the lower wall **14** of the groove **10**, whereby a pressure P, exerted against the upper lip **22**, is received or reacted not only by this lip **22**, but by the complete structure, because this pressure can be transmitted through the tongue **9** and the lower lip **23** to cause the panels to be urged towards each other.

It is, however, clear that a number of minor deviations to these complementary forms can occur which, anyhow, have no or almost no effect upon the receipt and transmission of pressure forces. For example, a chamfer **24** on lip **22** and a recess **25** can be provided, as represented in FIGS. **2** to **4**, as a result of which the subsequent floor panels **1** can easily be pushed and guided into each other, such that no possible ridges in the subflooring or such render good insertion difficult.

As represented in the FIGS. **5** to **7**, the floor panels **1** according to the invention can also, along the sides **26**–**27** which are at a right angle to the sides **2**–**3**, be provided with coupling parts **28**–**29** which have locking elements **30**, too. The coupling parts **28**–**29** are preferably also realized in the shape of a tongue **31** and a groove **32**. Hereby, the locking elements **30** do not have to be of the same nature as the locking elements **6**.

Preferably, at the sides **26**–**27** locking elements are provided which allow for an engagement and interlocking by means of a lateral translation movement in direction T only, as represented in FIGS. **6** and **7**. To this aim, the locking elements **30** consist of a snap-together connection with locking elements **33** and **34** which grip behind each other.

As represented in FIGS. **5** to **7**, the locking element **33** preferably consists of a protrusion of the lower side **35** of the tongue **31** which can be located in a recess **36** in a lower lip **43** extending distally from the lower wall **37** of the groove **32**. The locking element **34** is formed by the upward directed part or protrusion which defines the distally outer end of recess **36**.

In this case, the locking elements **33**–**34** have contact surfaces **38**–**39** which are parallel to each other and preferably extend in an inclined manner, according to a direction which simplifies the snapping-together of the panels. The

common plane of tangency L which is determined by the common tangent at the meeting point or area of surfaces **38–39**, hereby forms an angle A sloping inwardly and downwardly from an outer region to an inner region relative to the underside **7**, which angle is smaller than 90°.

The locking elements **33–34** preferably are provided with inclined portions **40** and **41** which, when two floor panels **1** are engaged, cooperate with each other in such a manner that the locking elements **33–34** can easily be pushed over each other until they grip behind each other by means of a snap-together effect (FIGS. **6** and **7**).

The thickness W1 of the tongue **31** preferably is equal to the width W2 of the groove **32**, such that compression pressure P applied to the upper lip **42** is reacted by the tongue **31** which, in its turn, then is reacted by the lower lip **43**.

Analogous to the chamfer **24** and recess **25**, a recess **44** and a chamfer **45** are provided also at the edges **28–29**.

It is noted that such a snap-together coupling can also be applied at the edges **2–3**. Hereby, this can be a snap-together coupling analogous to these of FIGS. **5** to **7**, but this can also be a snap-together coupling using other forms of coupling configurations, for example, such as represented in FIGS. **8** and **9**. Contrary to the locking elements **33–34** which consist of rather local protrusions, in the forms of embodiment of FIGS. **8** and **9** use is made of locking elements **46–47** which, in comparison to the total width B of the coupling, extend over a rather large distance.

In this case, the locking elements **46–47** are also provided at the lower side **12** of the tongue **9** and the lower wall **14** of the groove **10**.

According to FIG. **8**, the locking elements **46–47** have contact surfaces **48–49** which are at an angle with the plane of the floor panel **1**. In this manner, a coupling is obtained which is interlocked in a particularly fixed manner.

As represented in FIG. **9**, the locking elements **46–47** possibly can be configured in such a manner that substantially only a linear contact is obtained, for example, because the contact surfaces directed towards each other are formed with different curvatures.

The surfaces, directed towards each other, of the locking elements **46–47** hereby consist of curved surfaces. The common plane of tangency L forms an angle A which is smaller than 90°, and more preferably is smaller than 70°.

In this manner, the locking element **46** preferably has two portions with a different curvature, on one hand, a portion **50** with a strong curvature and, on the other hand, a portion **51** with a weak curvature. The portion **50** with the strong curvature provides for the formation of a firm coupling. The portion **51** with the weak curvature facilitates the coupling parts **4–5** to be brought into each other easily. The intermediate space S forms a chamber which offers space for dust and the like which, when engaging two floor panes **1**, inevitably infiltrates there.

In the case of a snap-together connection, for example, a connection such as represented in FIGS. **7** to **9**, preferably the tongue **9–31** has a shape that thickens from below, which then can cooperate with a widened portion in the groove **10**.

In FIG. **10**, a variant is represented whereby at least at the level of the upper edges **15–16**, a sealing material **52** is provided, as a result of which a watertight sealing can be assured. This sealing material **52** may consist of a strip or covering which is provided previously at the floor panel **1**, either at one or both upperside edges **15–16**.

In FIG. **11**, a further variant is represented, whereby the locking element **6** is formed by an upward directed portion **53** at the tongue **9**, which as a result of a turning movement of the panel, is brought behind a downward-directed portion **54** on the upper wall **18**. More particularly, this is obtained by forming the upper side **17** and the upper wall **18** with a curvature R3, the center of which is situated at the upperside edges **15–16**, and forming the lower side **12** and the lower wall **14** with a radius R4, the center of which is also situated at the upperside edges **15** and **16**, respectively. These radii R3–R4 can be chosen otherwise, too.

In general, according to the invention, the difference between, on one hand, the radius R1, R3 respectively, and, on the other hand, the radius R2, R4 respectively, preferably should not be larger than 2 mm.

It is also preferred that the center of these radii be situated inside the circle C1, C2 (see FIG. **2**) respectively, which extends with a radius R5 of 3 mm centered at upperside edge **15**, **16** respectively.

Finally is noted that, according to the invention, the lower lip **23–43**, as represented in FIGS. **2** to **7**, can be formed distally longer than the upper lip **22–42**. This has an advantage that the coupling parts **4–5–28–29** can be shaped in an easier manner by means of a milling cutter or the like. Furthermore, this simplifies the engagement of two floor panels **1**, because each subsequent floor panel **1** during installation can be placed upon the protruding lower lip **23–43**, as a result of which the tongue **9–31** and the groove **10–32** automatically are positioned in front of each other.

The embodiments wherein the lower lip **23** is equal to or distally shorter than the upper lip **22**, in their turn, offer the advantage that no protruding lip **23** remains at the extreme edge of the floor which might cause problems in finishing the floor installation.

In order to allow for a smooth assembly, to guarantee the necessary stability and firmness and in order to limit the quantity of material to be cut away, the difference E between the distally outer edge of the upper lip **22–42** and the distally outer edge of the lower lip **23–43**, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove **10**, should preferably be kept smaller than one time the total thickness F of the floor panel **1**. For stability's sake, normally this total thickness F shall never be less than 5 mm.

The small dimension of the difference E offers the advantage that the lower lip need not be strengthened by a reinforcement strip or the like.

According to a particular form of embodiment, the central line M1 through the tongue **9** and the groove **10** is situated lower than the center line M2 of the floor panel **1**, such, that the upper lip **22–42** is thicker than the lower lip **23–43**. In first instance, this is essential in this kind of connection, because then it is the lower lip **23–43** which bends, whereby the upper side of the floor panel **1** is kept free of possible deformations.

As explained in the introduction, for the core **8** a material is chosen from the following series:

a. a ground product which, by means of a binding agent or by means of melting together is made into a unitary composite material;
   a product based on synthetic material;
   chip board with fine chips.

The invention shows its usefulness, in first instance, preferably with laminated flooring, due to the reasons explained in the introduction.

As represented in the examples of the FIGS. **2** to **11**, such laminated flooring preferably consists of a core **8** made of MDF medium density fiberboard board, HDF high density

fiberboard board or similar, whereby at least at the upper side of this core **8** one or more layers of material are provided.

More particularly, it is preferred that the laminated flooring is provided with a decorative layer **55** and a protective top layer **56**. The decorative layer **55** is a layer, impregnated with resin, for example, made of paper, which can be imprinted with a variety of patterns, such as a wood pattern, a pattern in the form of stone, cork, or similar or even with a fancy pattern. The protective top layer **56** preferably also consists of a layer saturated with resin, for example, melamine resin, which in the final product is transparent.

It is clear that still other layers can be applied, such as an intermediate layer **57** upon which the decorative layer **55** is provided.

Preferably, also a backing layer **58** shall be applied at the underside **7**, forming a counterbalancing element for the top layers and, thus, guaranteeing the stability of the form of the floor panel **1**. This backing layer **58** may consist of a material, for example paper, impregnated with a resin, for example, a melamine resin.

As represented schematically in FIG. **12**, the tongue **9** and the groove **10**, and preferably also the tongue **31** and the groove **32** are formed by means of a milling process. In the case that a profile has to be applied on all four sides, the floor panels **1** preferably shall be displaced by means of two sequential perpendicular movements V**1** and V**2**, whereby during the first movement profiles at two opposite edges are provided, in this case the longitudinal edges, by means of milling devices **59–60**, whereas during the second movement profiles are provided at the other edges, in this case the small edges, by means of milling devices **61–62**. During these processing, the floor panels **1** preferably are put with their decorative layer directed downward.

According to an important characteristic of the invention, each respective tongue **9–31** and groove **10–32** are formed by means of a milling process with at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in reference to the related floor panel **1**.

This is illustrated in FIGS. **13**, **14** and **15**, wherein it is represented how a groove **10** is realized by means of two milling cycles by means of two milling cutters **63** and **64**. FIGS. **16** and **17** represent how the tongue **9** is shaped by means of milling cutters **65** and **66**.

The FIGS. **18–19** and **20–21** represent similar views showing how the groove **32** and the tongue **31** are shaped by means of milling cutters **67–68** and **69–70**, positioned at an angle.

During each of the aforementioned milling passes, substantially the final shape of one flank is fully realized. For example, the milling cutter **63** of FIG. **14** determines the final shape of the lower flank **71** of the groove **10**, whereas the milling cutter **64** determines the final shape of the upper flank **72**.

As mentioned in the introduction, preferably milling cutters **63** to **72** shall be used, having diameters G which are at least 5 times, and even better at least 20 times larger than the thickness F of the floor panels **1**.

Apart of the mentioned milling cutters, preferably still other milling cutters are applied, for example, in order to remove a part of the material to be removed during a first premachining cycle.

In the FIGS. **22** to **25**, a particularly preferred form of embodiment of a floor panel **1** according to the invention is represented. Hereby, the parts which correspond with the previous embodiments are indicated with corresponding references.

An important characteristic herein consists in that the coupling parts **4–5** are provided with locking elements **6** which, in engaged condition with the panels in a common plane, exert a tension force upon each other, as a result of which the engaged floor panels **1** are forced towards each other in compression. As represented, this is realized preferably by providing the coupling parts with an elastically yieldable or bendable portion, in this case the lower lip **43**, which, in engaged condition, is at least partially bent from a relaxed, unbent position and in this way creates a tension force which results in the engaged floor panels **1** being forced towards each other. The resultant bending V, as well as the tension force K, are indicated in the enlargement view of FIG. **23**.

In order to obtain the tension force K pressing together the engaged floor panels **1**, the bendable portion, in this case the lip **43**, preferably is provided, as represented, with an inwardly and downwardly inclined contact surface **73** which preferably can cooperate with a corresponding contact surface **74** on tongue **9**. These contact surfaces **73–74** are similar to the aforementioned contact surfaces **39–38** and also similar to the inclined portions of the lower lip of FIGS. **2** to **4**.

In the FIGS. **2** and **5**, the portions form complementary matching shapes; it is, however, clear that, by a modification, also a tension effect similar to that shown in FIG. **23** can be realized.

Due to, on one hand, the contact along the angle A, and, on the other hand, the fact that a tension force K is created, a compression force component K**1** is produced, as a result of which the floor panels **1** are drawn against each other in compression.

Preferably, the angle A of the mutual plane of tangency of contact surfaces **73–74** relative to the horizontal plane is situated between 30 and 70 degrees. In the case that use is made of the embodiment whereby a tension force K is realized, an angle A of 30 to 70 degrees is ideal in order, on one hand, to effect an optimum pressing-together of the floor panels **1** and, on the other hand, to ensure that the floor panels **1** can easily be engaged and respectively disassembled.

Although the pressing or compression force component K**1** preferably is delivered by the aforementioned lip **43**, the invention does not exclude other forms of locking elements or structures whereby this force is delivered by other bendable portions.

It is noted that the bending V is relatively small, for example, several hundredths up to several tenths of a millimeter, and does not have an influence upon the placement of the floor covering. Furthermore it should be noted that such floor covering generally is placed upon an underlayer (not shown) which is elastically compressible, as a result of which the bending V of the lip **43** only produces local bending of the underlayer.

Due to the fact that the lip **43** is bent apart and that it remains somewhat bent apart in engaged position, the additional advantage is obtained that, when exerting a pressure upon the floor covering, for example, when placing an object thereupon, the pressing-together compressive force is enhanced and, thus, the development of gaps is counteracted even more.

It is noted that the inventors have found that, contrary to all expectations, an ideal tension force can be realized by manufacturing the coupling parts **4–5**, including the locking elements **33–34**, and preferably the complete core **8**, of HDF board or MDF board, although these material normally only allow a minor elastic deformation.

HDF and MDF also offer the advantage that smooth surfaces are obtained, as a result of which the locking elements can be moved easily over each other.

According to a variant of the invention, the tension force can also be supplied by means of an elastic compression of the material of the coupling parts themselves, to which end these coupling parts, and preferably the complete core **8**, would be manufactured using an elastically compressible material.

A further particular characteristic of the embodiment of FIGS. **22** to **25** consists in that the floor panels **1** can be selectively engaged by means of a turning movement, as represented in FIG. **24**, as well as by means of laterally shifting them towards each other in substantially a common plane, as represented in FIG. **25**, preferably in such a manner that, during the engagement by means of the turning movement with the coupling parts partially engaged, a maximum bending Vm results in the coupling parts, more particularly in the lip **43**, which bending Vm is less pronounced, if not nonexistent, as in the FIGS. **2** to **4**, in comparison to the bending Vm which results when the floor panels **1** are engaged by means of shifting them towards each other, as in FIG. **15**.

The advantage of this consists in that the floor panels **1** can be engaged easily by means of a turning movement, without necessitating use of a tool therefore, whereas it still remains possible to engage the floor panels also by means of shifting them laterally. This latter is useful, in first instance, when the last panel has to be placed partially under a door frame or similar situation. In this case, the floor panel **1** can be pushed under the door frame with the side which does not have to be engaged and subsequently, possibly by means of tools, can be snapped into the adjacent floor panel by lateral sliding together.

It is noted that the shapes of the coupling parts **4–5** shown in FIGS. **22** to **25** can also be used for the coupling parts **28–29** of the short sides of the panels.

According to the invention, in the case that the four sides **2–3–26–27** are provided with coupling pars **4–5–28–29**, these coupling parts can be formed in such a manner that in one direction a firmer engagement than in the other direction is effected. In the case of elongated floor panels **1**, for example, such as represented in FIG. **1**, the locking at the small sides **26–27** preferably shall be more pronounced than at the longitudinal sides **2–3**. The length of the parts at the small sides, namely, is smaller and, in principle, less firm. This is compensated for by providing a more pronounced locking.

This difference in engagement can be obtained by shaping the contact surfaces **73–74** with different angles.

Preferably, the aforementioned protrusion, more particularly the locking element **33**, is bounded by at least two portions **75–76** (shown in FIG. **22**), respectively a portion **75** with a strong (steep) inclination which provides for the locking, and a portion **76** with a weaker (less inclined) inclination which renders the engagement or guidance of the coupling parts easier. In the embodiment of FIGS. **22** to **25**, these portions **75–76** are formed by straight planes, but, as already described with reference to FIG. **9**, use can also be made of curved portions **50–51**. In FIG. **5**, these are the contact surface **38** and the inclined portion **40**.

In the preferred form of the invention, the floor panels **1** comprise coupling parts **4–5** and/or **28–29** exhibiting one of the following or the combination of two or more of the following features:

- a curvature **77** (shown in FIG. **22**) at the lower side of the tongue **9** and/or a curvature **78** at the lower lip **43** which form a guidance when turning two floor panels **1** into each other, with the advantage that the floor panels **1** can be engaged into each other easily during installation;
- roundings **79–80** at the edges of the locking elements **33–34**, with the advantages that the locking elements can easily shift over each other during their engagement, or during disassembly of the floor panels **1** and that the locking elements will not be damaged, for example, crumble away at their edges, even if the floor panels are engaged and disassembled;
- dust chambers **81**, or spaces **21** as in FIG. **4**, between all sides, directed laterally towards each other, of the engaged floor panels **1**, with the advantage that inclusions which get between the floor panels **1** during the engagement do not exert an adverse influence upon good engagement;
- a shaping of the tongue **9** which is such, for example, by the presence of a chamfer **82**, that the upper side of the tongue **9** becomes situated from the first joining together or substantial contact of the panels, under the lower side of the upper lip **42** when the floor panels **1** are pushed towards each other in substantially the same plane, as indicated in FIG. **25**, with the advantage that the front extremity or end of the tongue **9** does not press against the front side of the upper lip **42** or the front edge of the bottom lip **43** when the floor panels are pushed towards each other in the same plane;
- a ramp surface **83**, hereinbefore also called inclined portion **41**, formed at the distally outer end of the lower lip **43**, with the advantage that the locking elements **33–34** shift smoothly over each other and that the lower lip **43** is bent uniformly;
- in the engagement direction only one important contact point which is formed by a section **84** at the location of the upper side edges of the floor panels **1**, with the advantage that the aforementioned tension force is optimally transferred to the upper side of the floor panels **1** and that the development of openings between the floor panels **1** is counteracted;
- contact surfaces **85–86**, more particularly abutment surfaces, formed by the upper side of the tongue **9** and the upper side of the groove **10** which, over the largest portion of their length, are flat and run parallel to the plane which is defined by the floor panels **1**, as well as contact surfaces cooperating with each other, formed by curvatures **77–78**, with the advantage that no mutual displacement in height between two engaged floor panels **1** is possible, even if the insertion depth of the tongue **9** into the groove **10** should vary due to various causes; in other words, no height differences may occur between the adjacent floor panels.

In the embodiment of FIGS. **22** to **25**, all these characteristics are combined; it is, however, clear that, as becomes evident from FIGS. **2** to **11**, these features can also be provided separately or in a limited combination with one another.

As becomes evident from FIGS. **5** to **7** and **22** to **25**, an important characteristic of the preferred embodiment of the invention consists in that the cooperative locking element **6**, in other words, the portion providing for the snap-together and engagement effect, are situated in that portion of the lower lip **23–43** which extends beyond the distal edge of the upper lip **22–42**, more particularly, the lowermost point **87** of the locking part **33** is situated under the top layer of the floor panel **1**. For clarity's sake, this top layer is indicated in the FIGS. **22–25** only as a single layer.

It should be noted that the combination of features, the lower lip **23**–**43** extending further than the upper lip **22**–**42**; the locking elements **6** being formed at least by means of a contact surface portion which inwardly slopes downward, and wherein this portion, at least partially, is located in the portion of the lower lip **23**–**43** which extends distally beyond the upper lip **22**–**42**, is particularly advantageous, among others, in comparison with the couplings for floor panels described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The sloping contact surface portion offers the advantage that the floor panels **1** can be disassembled again. The fact that this sloping portion is situated in the extended portion of the lower lip **23**–**43** adds the advantage that no deformations can occur during coupling which manifest themselves up to the top layer.

According to a preferred characteristic of the invention, the aforementioned portion, i.e. the contact surface **39** or **73**, preferably extends in such a manner that the distance between the upper edge **16** of the panel to the contact surface **39**, **73** diminishes between the proximal and distal ends of the sloping contact surface **39**, **73**, in other words, such that, as represented in FIG. **22**, the distance X**2** is smaller than the distance X**1**. This is also the case in FIG. **7**.

Still preferably, this portion only starts at a clear distance E**1** from the outer edge of upper lip **42**.

It is obvious that the coupling parts **22** to **25** can also be shaped by means of said milling process.

According to a particular characteristic of the invention, the floor panels **1** are treated at their sides **2**–**3** and/or **26**–**27** with a surface densifying agent, more particularly a surface hardening agent, which preferably is chosen from the following series of products: impregnation agents, pore-sealing agents, lacquers, resins, oils, paraffins and the like.

In FIG. **22**, such impregnation **88** is represented schematically. This treatment can be performed over the complete surface of the sides **2**–**3** and/or **26**–**27** or only over specific portions hereof, for example exclusively on the surfaces of the tongue **9** and the groove **10**.

The treatment with a surface densifying agent offers, in combination with the snap-together effect, the advantage that in various aspects better coupling characteristics are obtained. As a result of this, the coupling parts **4**–**5** and/or **28**–**29** better keep their shape and strength, even if the floor panels **1** are engaged and disassembled repeatedly. In particular, if the core **8** is made of HDF, MDF or similar materials, by means of this treatment a better quality of surface condition is obtained, such that no abrasion of material occurs during engaging, or during disassembling.

This treatment also offers the advantage that, at least in the case of a surface hardening, the aforementioned elastic tensioning effect is enhanced.

The present invention is in no way limited to the forms of embodiment described by way of example and represented in the figures, however, such floor covering and the pertaining floor panels **1** can be embodied in various forms and dimensions without departing from the scope of the invention.

For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other.

Furthermore, all embodiments of coupling elements described before can be applied at the longer side as well as at the shorter side of a panel.

What is claimed is:

1. A floor covering panel comprising a substantially planar under side and at least two opposed side edges;

said side edges including cooperative coupling parts configured to cooperate with identical cooperative complementary coupling parts of another one of said panel;

said coupling parts comprising substantially a tongue and a groove extending distally transversely along panel side edges including mechanical locking elements;

said tongue, groove and locking elements formed in one piece with the panel;

said tongue groove and locking elements cooperating to prevent drifting apart of the floor panel when coupled by said coupling parts to another one of said floor panel in directions perpendicular to the adjacent side edges of the coupled panels, and parallel to the undersides of the coupled panels;

a coupling part of said panel, when engaged with a cooperating coupling part of another one of said panel, urging the coupled panels towards each other;

at least one of said coupling parts including an elastically bendable portion having a relaxed unbent position, and which, when in a coupled condition, is at least slightly bent out of its normal relaxed unbent position to effect said urging of the coupled panels together.

2. The floor covering panel according to claim **1**, wherein the elastically bendable portion of said one of said coupling parts comprises a lower lip defining at least in part a lower side of the groove of said coupling parts, said lower lip cooperating with a mating portion of a tongue of a cooperating coupling part when the cooperating parts are coupled.

3. The floor covering panel according to claim **2**, wherein said lip when elastically bent extends in a downward direction relative to the panel underside when the panel is coupled by said coupling parts to another one of said panel.

4. The floor covering panel according to claim **3**, wherein the panel comprises a core comprising a material selected from the group consisting of HDF and MDF;

a lower lip of a coupling parts is substantially formed of said core; one of said locking elements comprises a recess in said lower lip, said recess having a lowermost bottom area;

said groove of said coupling parts having a deepest point within the panel; and

wherein said elastically bendable portion of the lower lip comprises a portion of said lower lip located between the deepest point of said groove and the lowermost bottom area of said recess.

5. The floor covering panel according to claim **4**, wherein a portion of the lower lip that is elastically bendable includes a side wall area of said recess that slopes downwardly in a direction extending from a distally outer area of said lip towards a proximally inner area of said lip.

6. The floor covering according to any one of claims **1** to **5**, wherein upon coupling the coupled panels are urged together without play.

* * * * *

EXHIBIT D

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Moriau et al.

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(54) **FLOOR PANELS WITH EDGE CONNECTORS**

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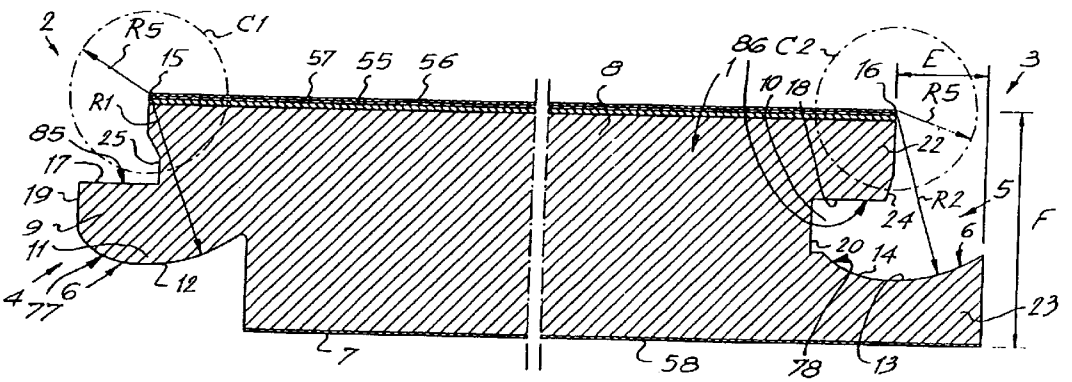
Primary Examiner—Carl D. Friedman
Assistant Examiner—Yvonne M. Horton
(74) *Attorney, Agent, or Firm*—Bacon & Thomas, PLLC

(57) **ABSTRACT**

Floor covering, including hard floor panels which, at least at the edges of two opposite sides, are provided with coupling parts, cooperating which each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges and parallel to the underside of the coupled floor panels, and provide a snap-action coupling.

29 Claims, 10 Drawing Sheets



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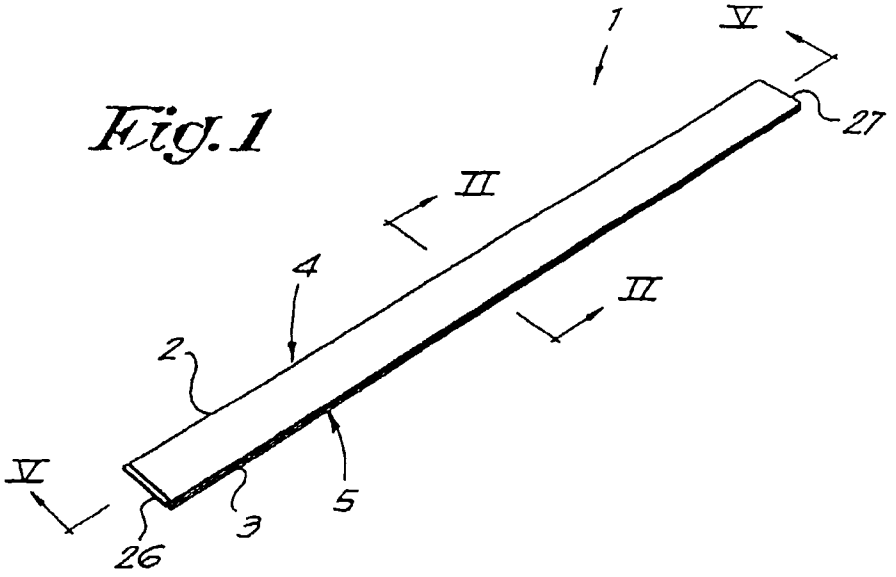
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Fig. 1

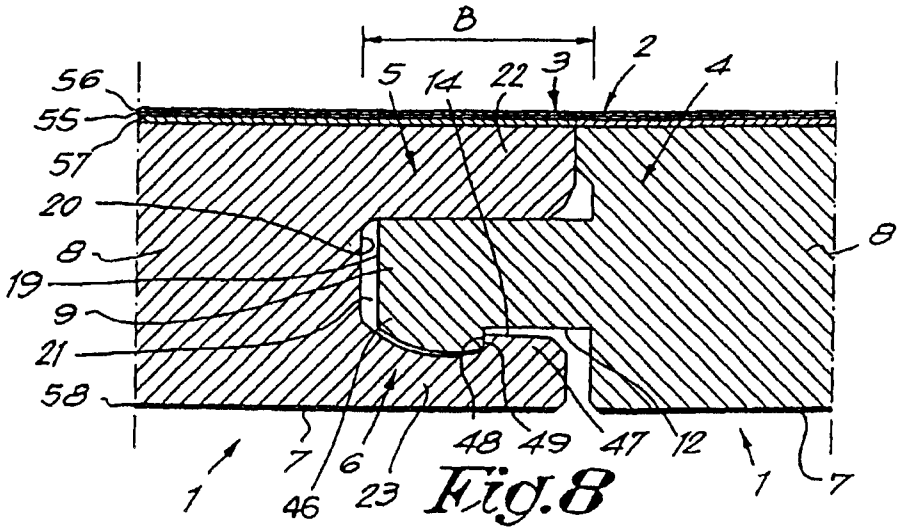
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Fig. 8

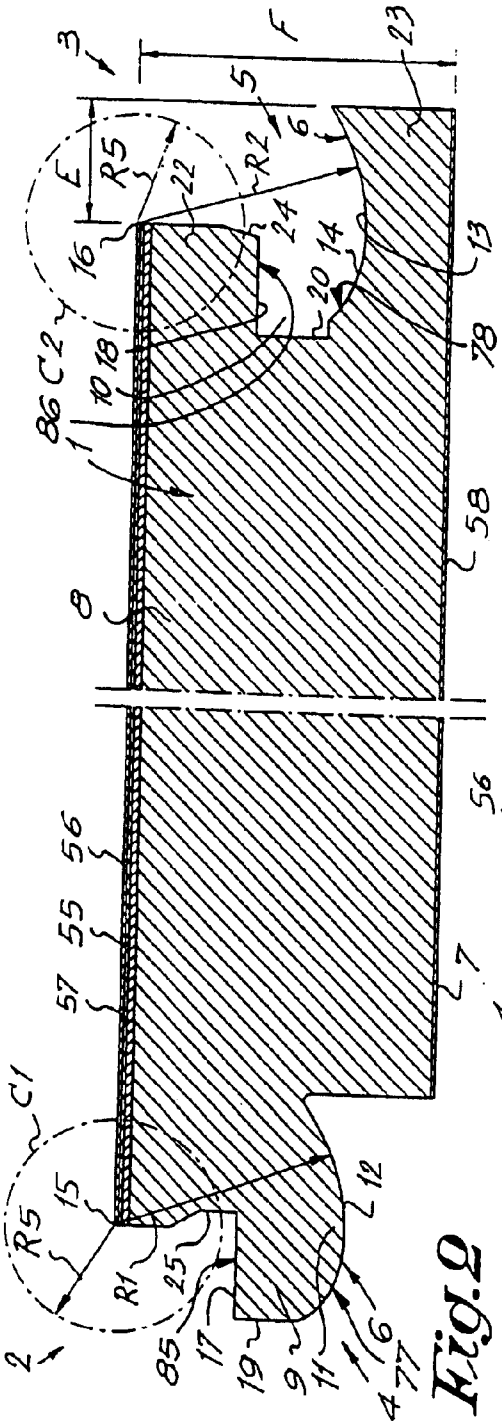

Fig. 2

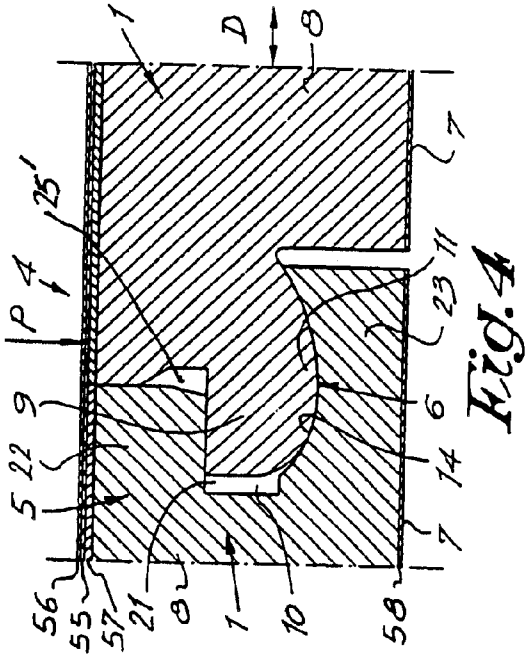

Fig. 4

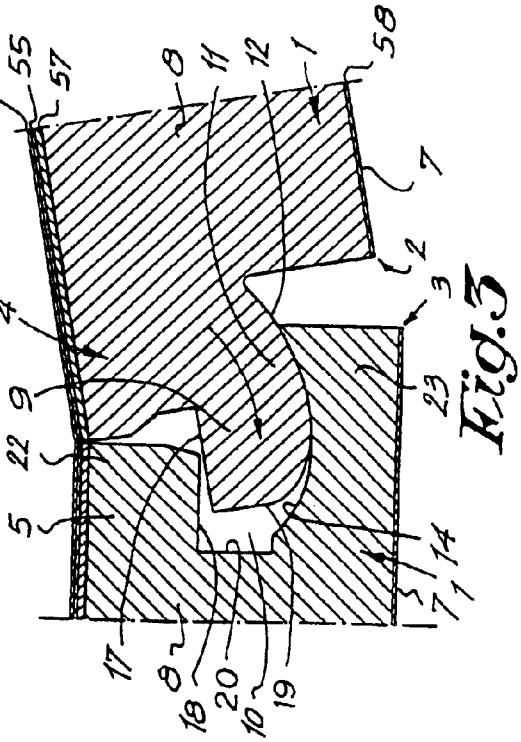

Fig. 3

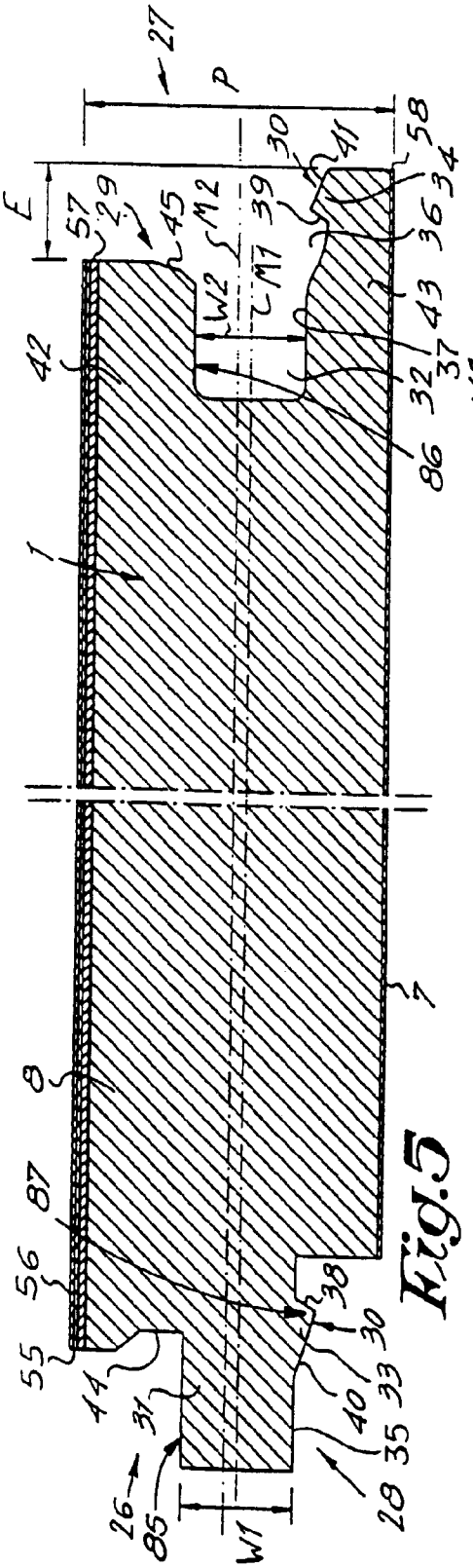

Fig.5

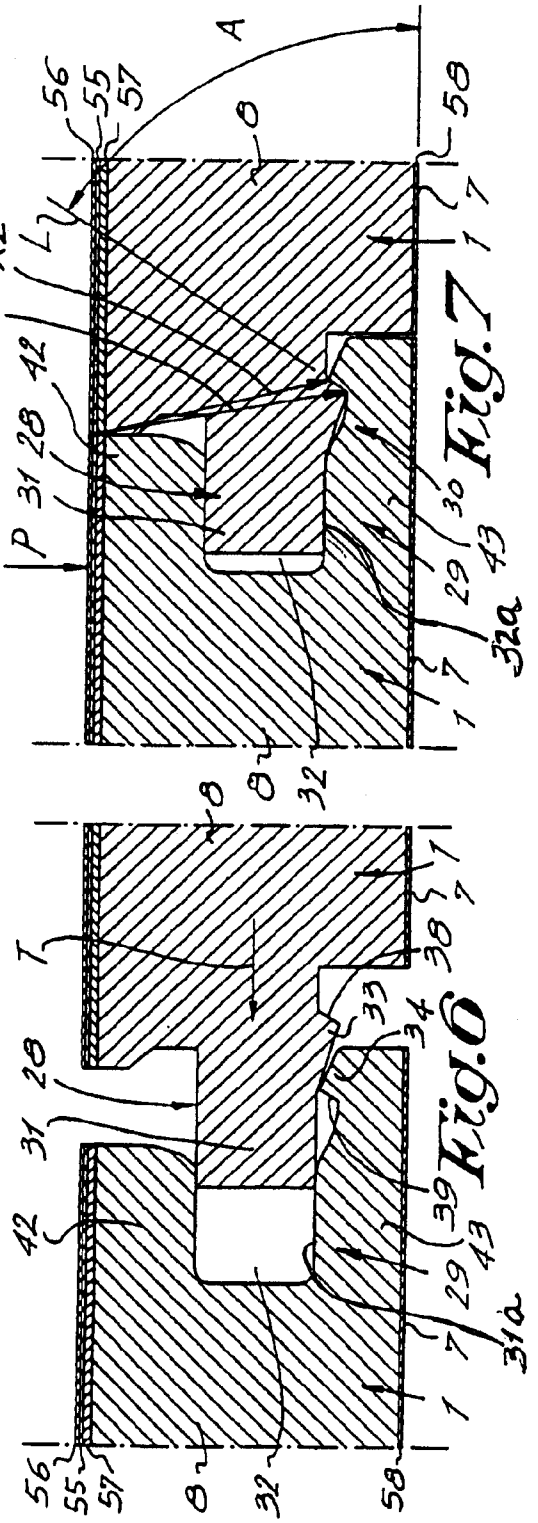

Fig.6

Fig.7

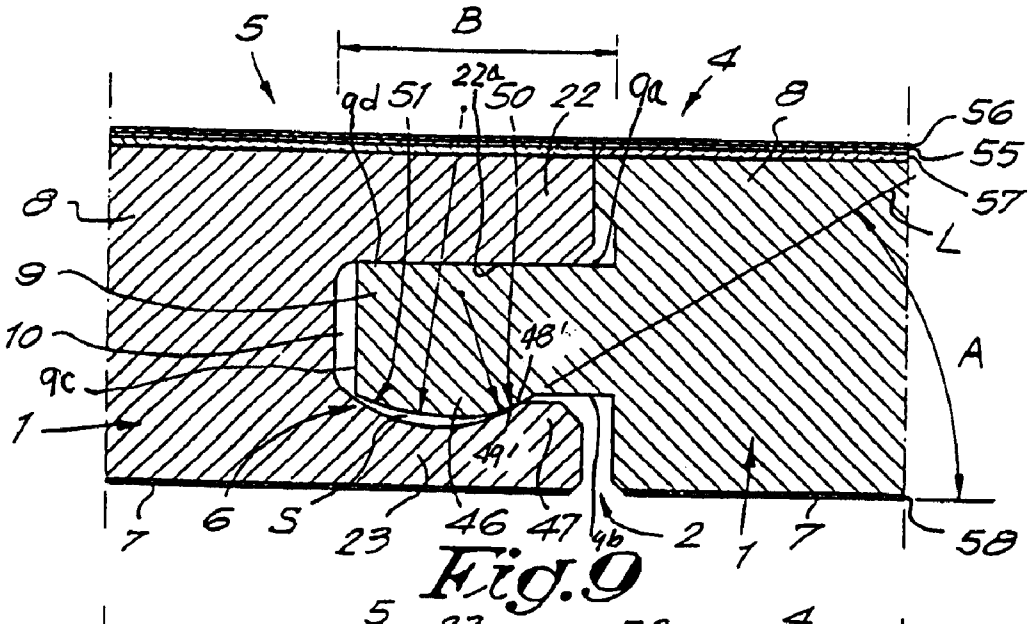

Fig.9

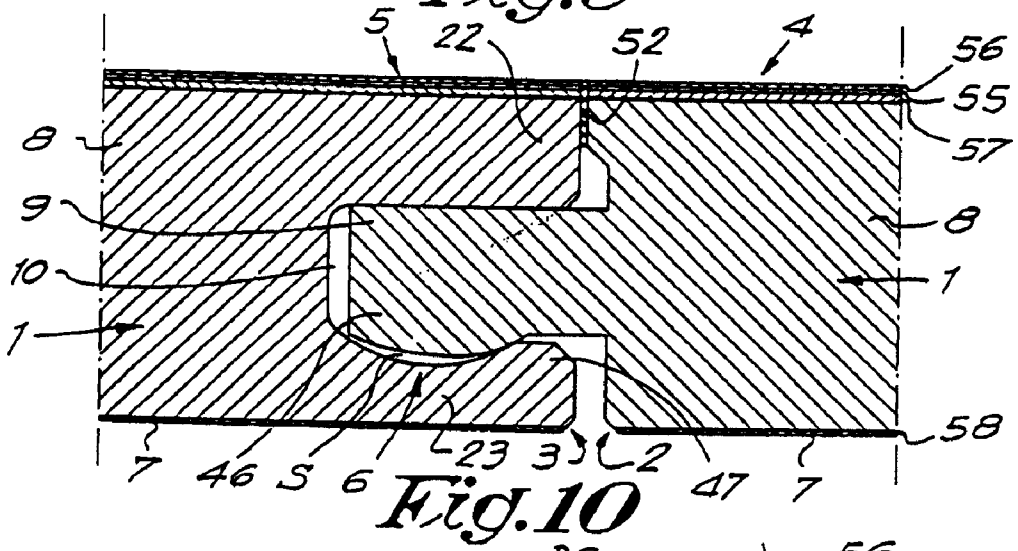

Fig.10

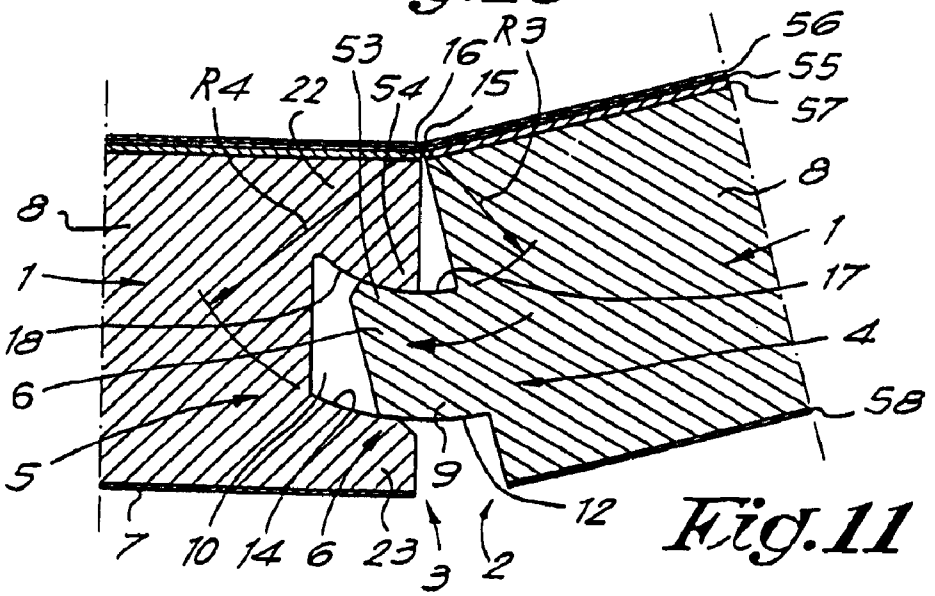

Fig.11

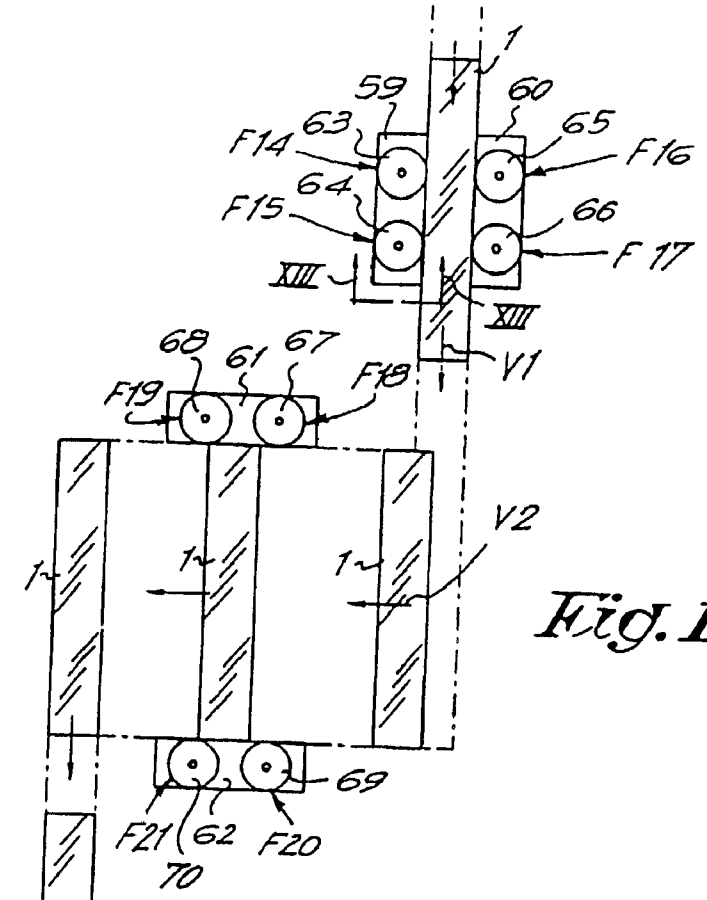
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Fig. 12

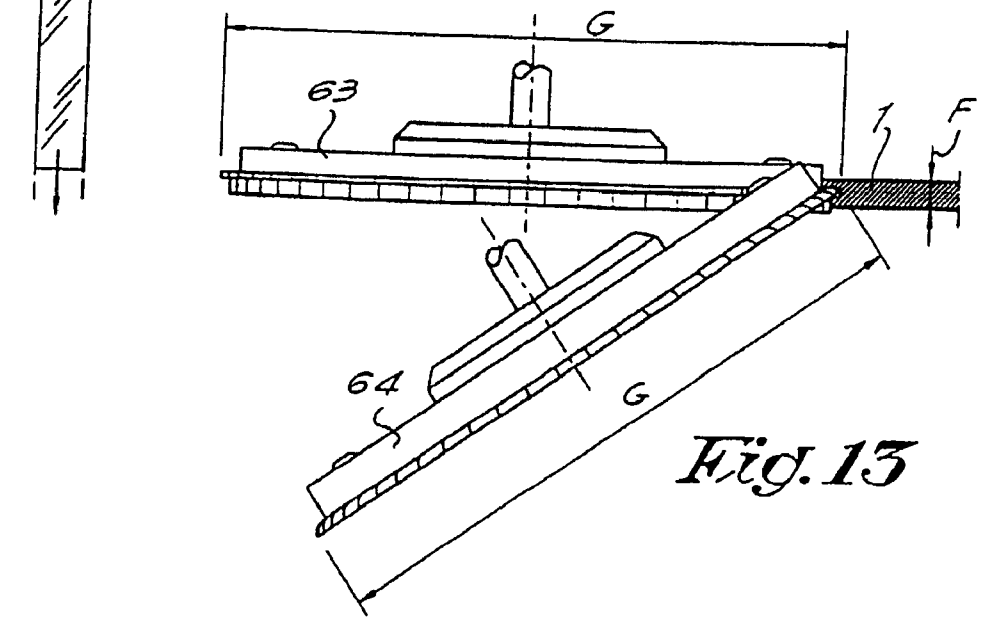
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Fig. 13

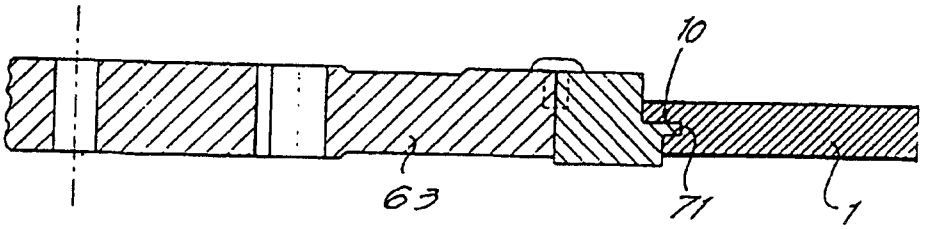

Fig. 14

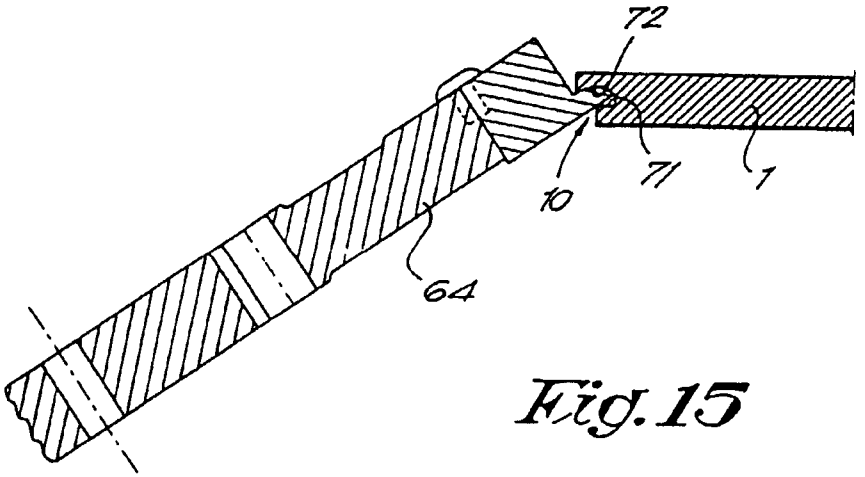

Fig. 15

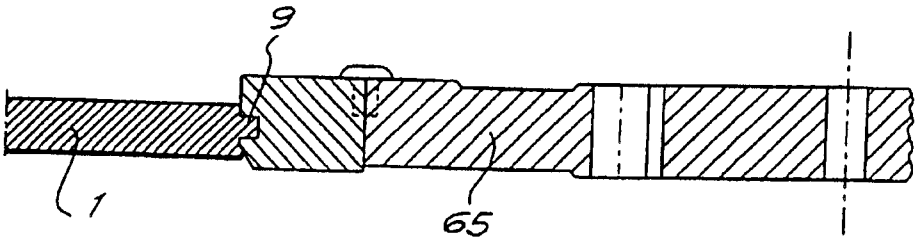

Fig. 16

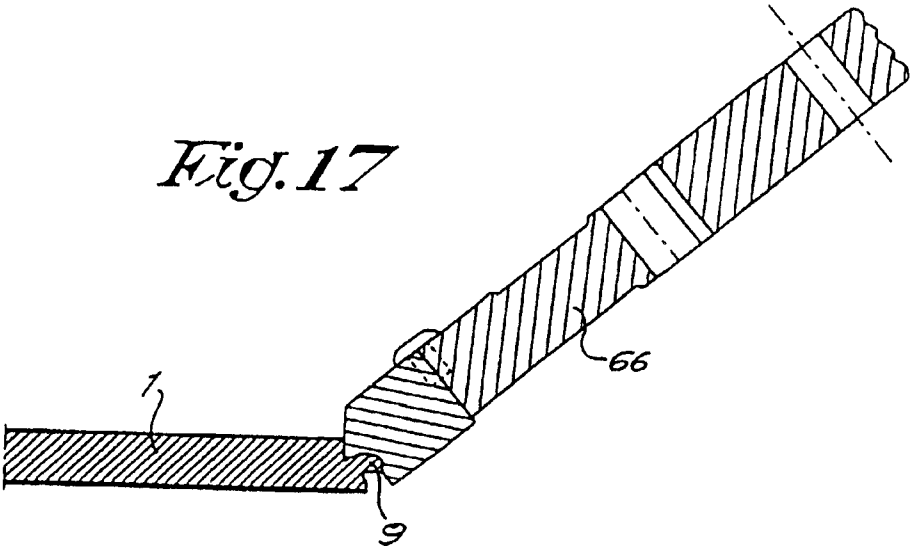

Fig. 17

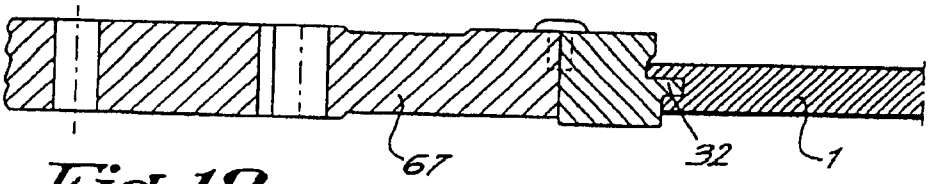

Fig. 18

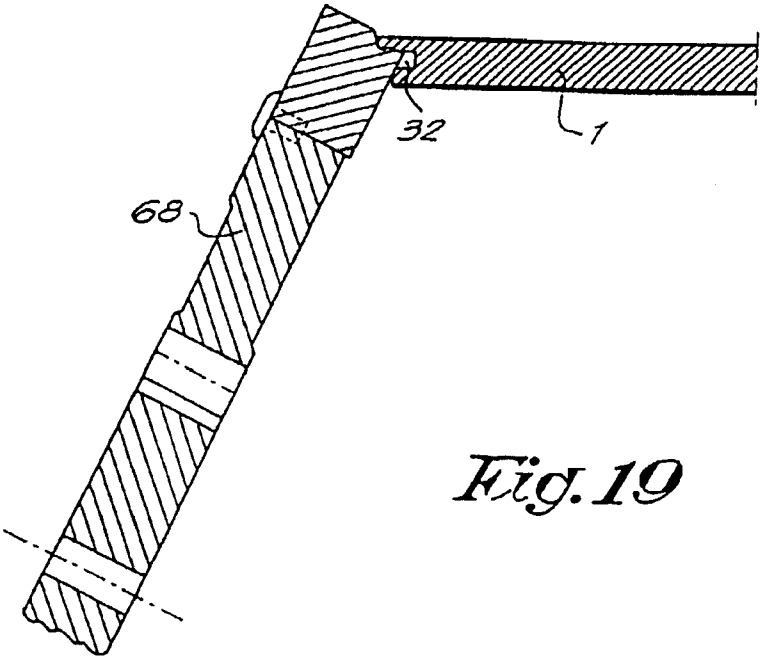

Fig. 19

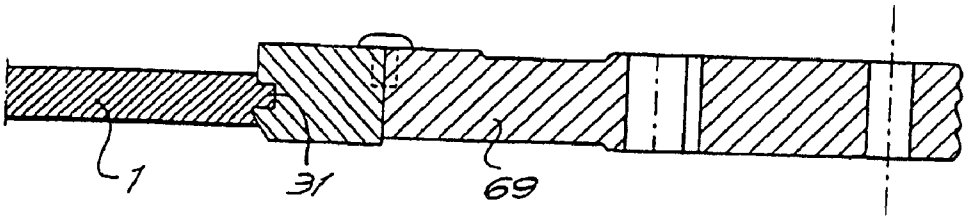

Fig.20

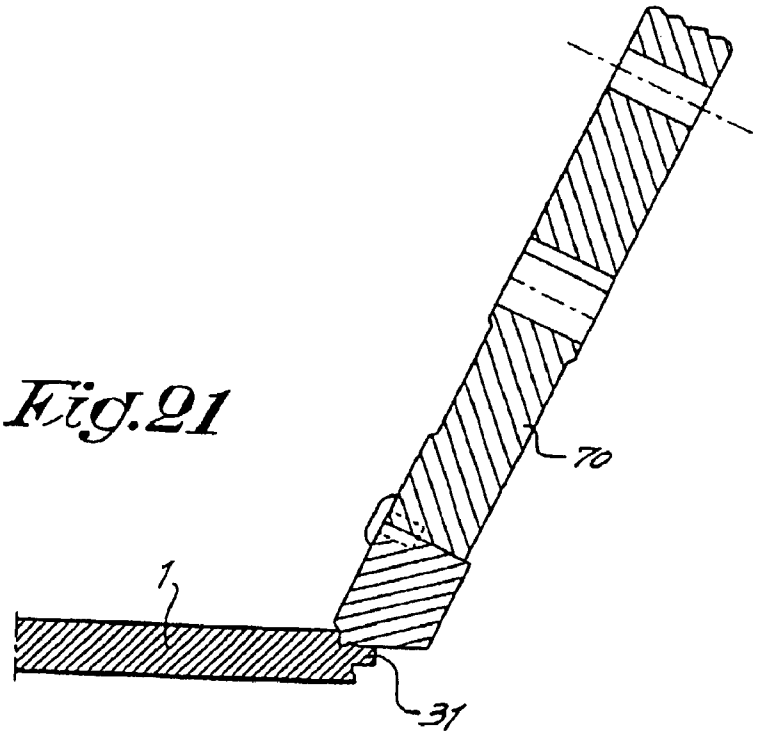

Fig.21

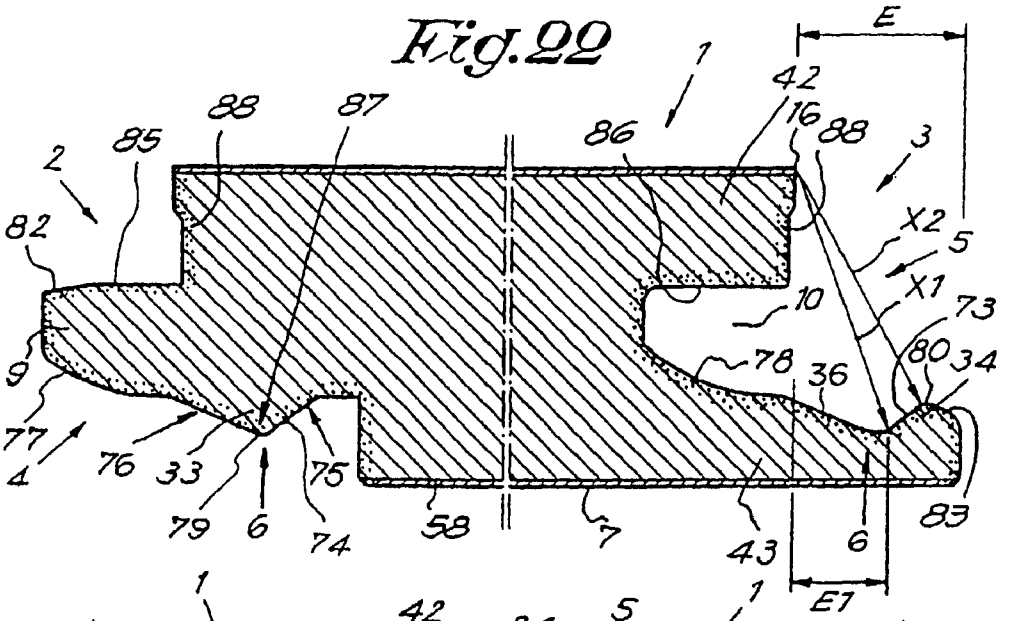
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Fig. 22

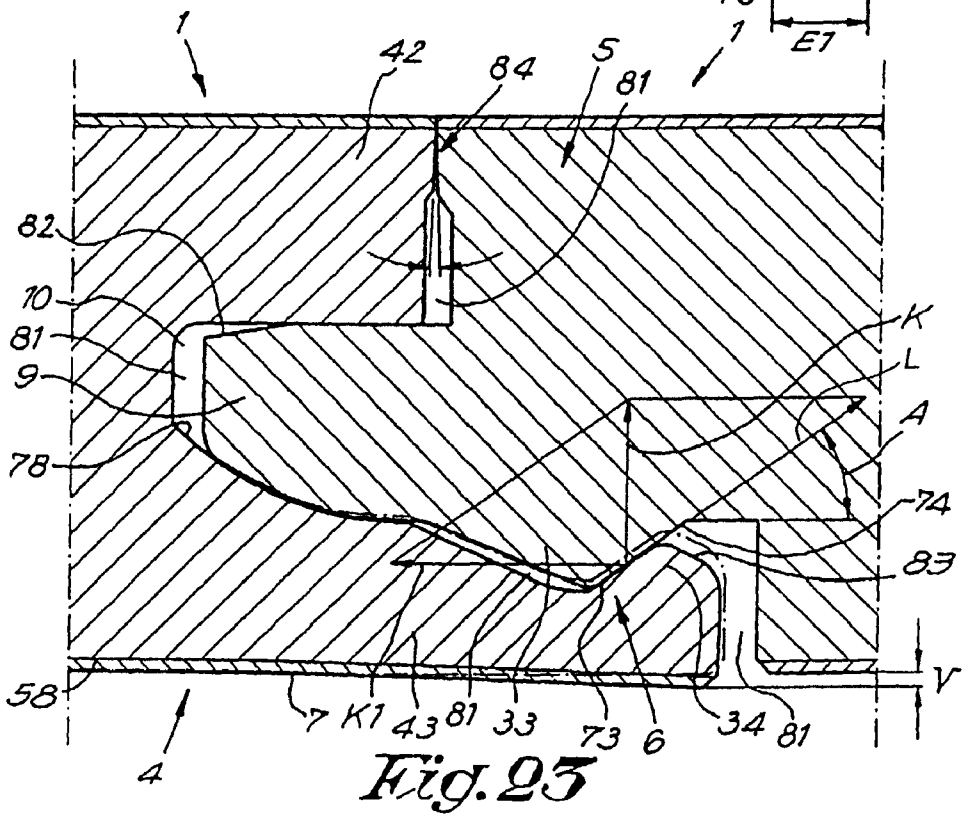
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Fig. 23

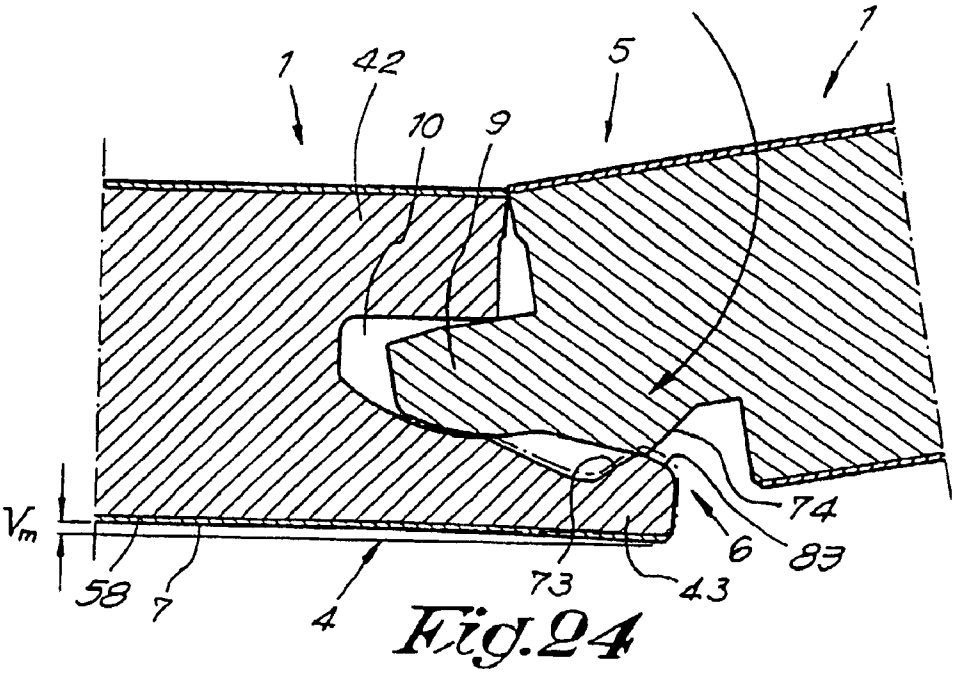
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Fig.24

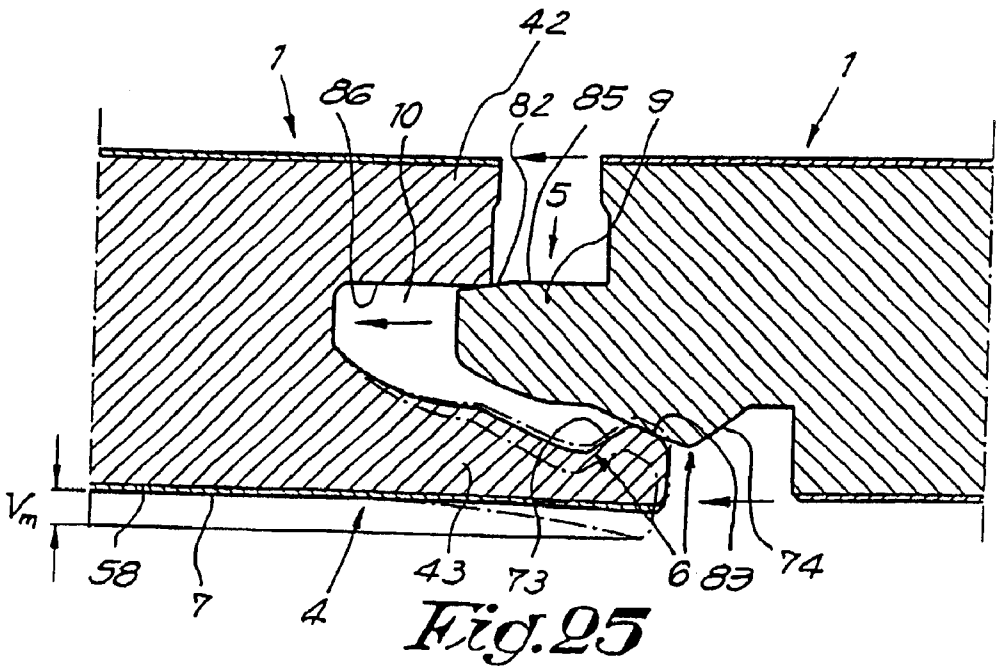
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Fig.25

FLOOR PANELS WITH EDGE CONNECTORS

RELATED APPLICATION DATA

This application is a continuation of pending application Ser. No. 09/471,014, filed Dec. 23, 1999, now U.S. Pat. No. 6,490,836; which is a continuation of application Ser. No. 08/872,044 filed Jun. 10, 1997, now U.S. Pat. No. 6,006,486.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to floor panels.

2. Related Technology

In the first instance, the invention is intended for so-called laminated floors, but generally it can also be applied for other kinds of floor covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring.

It is known that such floor panels can be applied in various ways.

According to a first possibility, the floor panels are attached at the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels.

According to a second possibility, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena.

A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks.

In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation.

Examples of embodiments which apply such metal connection elements are described, among others, in the documents WO 94/26999 and WO 93/13280.

Furthermore, couplings are known which allow coupling parts to snap fit into each other, e.g., from the documents WO 94/1628, WO 96/27719 and WO 96/27721. The snapping-together effect obtained with these forms of embodiment, however, does not guarantee a 100-percent optimum counteraction against the development of gaps between the floor panels, more particularly, because in fact well-defined plays have to be provided in order to be sure that the snapping-together is possible.

From GB 424.057, a coupling for parquetry parts is known which, in consideration of the nature of the coupling, only is appropriate for massive wooden parquetry.

Furthermore, there are also couplings for panels known from the documents GB 2.117.813, GB 2,256.023 and DE 3.544.845. These couplings, however, are not appropriate for connecting floor panels.

BRIEF SUMMARY OF THE INVENTION

The invention aims at an improved floor covering of the aforementioned type, the floor panels of which can be coupled to each other in an optimum manner and/or the floor panels of which can be manufactured in a smooth manner, and whereby preferably one or more of the aforementioned disadvantages are excluded.

The invention also aims at a floor covering which has the advantage that no mistakes during installing, such as gaps and such, can be created.

Furthermore, the invention also aims at a floor covering whereby the subsequent development of gaps is excluded or at least counteracted in an optimum manner, whereby also the possibility of the penetration of dirt and humidity is minimalized.

To this aim, the invention relates to a floor covering, consisting of hard floor panels which, at least at the edges of the two opposite sides, are provided with coupling parts, cooperating which each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels into a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels. Hereby, these coupling parts are optimalized in such a manner that they allow that any form of play is counteracted and preferably is excluded.

By integrated mechanical locking elements is understood that these form a fixed part of the floor panels, either by being connected in a fixed manner to the floor panels, or by being formed in one piece therewith.

In a first important preferred form of embodiment, the coupling parts are provided with locking elements which, in the engaged position of two or more of such floor panels, exert a tension force upon each other which force the floor panels towards each other. As a result of this that not only the formation of gaps counteracted during installation, but also in a later stage the development of gaps, from any causes whatsoever, is counteracted.

According to another characteristic of the intention, the coupling parts, hereby are formed in one piece with the core of the floor panels.

According to a second important preferred embodiment, the aforementioned optimalization is achieved in that the floor covering panel possesses the following combination of characteristics: the coupling parts and locking elements are formed in one piece with the core of the floor panels; the coupling parts have such a shape that two subsequent floor panels can be engaged into each other exclusively by snapping together and/or turning, whereby each subsequent floor panel can be inserted laterally into the previous; the coupling parts are interlocked free from play in all directions in a plane extending perpendicular to the aforementioned edges; the possible difference between the upper and lower lip of the lips which border the aforementioned grooves, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than one time the total of the thickness of the panel; the total thickness of each related floor panel is larger than or equal to 5 mm; and that the basic material of the floor panels, of which the aforementioned core and locking elements are formed, consists of a ground product which, by means of a binding agent or by means of melting together, is made into

a unitary composite, and/or of a product on the basis of synthetic material and/or of a chip board with fine chips.

Due to the fact that the coupling parts provide for an interlocking free from play, as well as due to the fact that these coupling parts are manufactured in one piece, from the basic material of the floor panels, a perfect connection between adjacent floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of characteristics can be combined or not with the aforementioned characteristic that the locking elements exert a tension force upon each other when panels are joined together.

According to a third important preferred embodiment, the characteristics of which may or may not be combined with the characteristics of the embodiments described above, the floor covering is characterized in that the lower lip which limits or defines the lower side of the groove, extends beyond the upper lip in the plane of the panel; the locking elements are formed at least of a contact portion which inwardly slopes downward; and that this portion, at least partially, is located in the portion of the lower lip which extends beyond the upper lip. The advantages of these features will appear from the further description.

According to a preferred form of embodiment, the floor panels are configured as elongated panels and the coupling parts described above are applied along the longitudinal sides of these panels.

According to a particular form of embodiment, coupling parts are provided at the other two sides, too, either of another construction than described above or not.

In the most preferred form of embodiment, for the basic material use shall be made of the aforementioned product, which, as said, is ground and, by means of a binding agent, made into a unitary composite material. More particularly, for the core use shall be made of finely-ground wood which preferably is glued, more particularly, moisture resistant glued. Still more particularly, for the core use shall be made of so-called HDF board (High Density Fibreboard) or MDF board (Medium Density Fibreboard) which is highly compressed ground wood particles (fibers) and binder material. Hereinafter, the wood component of the core material shall be referred to as "wood product".

The fact that the invention is applied to floor panels the basic material of which consists of the material described above, offers the advantage that with the processing of this material, very smooth surfaces are obtained whereby very precise couplings can be realized, which, in first instance, is important in the case of a snap-together connection and/or turning connection free from play. Also, very special forms of coupling parts can be manufactured in a very simple manner because the aforementioned kinds of material can be processed particularly easy.

The surfaces obtained with HDF and MDF also have the advantage that the floor panels mutually can be shifted readily alongside each other in interlocked condition, even when engaged with a tensioning force.

The applicants also discovered that the aforementioned materials, in particular HDF and MDF, show ideal features in order to realize a connection, such as mentioned above, as these material show the right features in respect to elastic deformation in order to, on the one hand, realize a snap-together effect, and, on the other hand, receive expansion and shrinkage forces in an elastic manner, whereby it is avoided that the floor panels come unlocked or are damaged in an irreparable manner.

In the case that for the core use is made of a material based on synthetic material, to this end solid synthetic material can be used as well as a mixture of synthetic materials, eventually composed of recycled materials.

The floor covering preferably is formed by joining the floor panels into each other free of glue. Hereby, the connections are of such nature that the floor panels can be disassembled without being damaged, such that, for example, when moving from one residence or location to another, they can be taken along in order to be placed down again. It is, however, clear that a glueing between tongue and groove is not excluded.

The invention, of course, also relates to floor panels which allow the realization of the aforementioned floor covering.

The invention also relates to a method for the manufacturing of the aforementioned floor panels with which the advantage that the tongues and/or grooves, including the corresponding locking means, can be provided at the floor panels at high production speeds without problems. More particularly, it aims at a method which allows that the rather complicated forms of the tongue and the groove of the aforementioned floor panels can be formed completely by means of milling cutters, the diameter of which can be chosen independent of the form to be realized, such that the use of small milling cutters, for example finger cutters, with diameters smaller than the depth of the tongue or groove can be excluded.

In accordance with this method the tongue and/or groove is formed by means of a milling process using at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in respect to the related floor panel. During each of the aforementioned milling cycles, preferably substantially the final form of one flank, either of the tongue or of the groove, is formed.

For the aforementioned two milling cycles, thus, milling cutters are used which extend outside the groove, respectively the tongue. More particularly the diameters of these milling cutters shall at least be 5 times and even better 20 times larger than the thickness of the floor panels.

The use of milling cutters having the aforementioned diameters has as an advantage that the normal production speeds can be maintained which are also applied during milling of a classical straight tongue and groove. There is also the advantage obtained that the installation of such milling cutters induce only minor or no additional costs because such milling cutters can be placed directly upon a motor shaft and/or the conventional machines can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

With the intention of better showing the characteristics according to the invention, in the following, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

FIG. **1** represents a floor panel of a floor covering according to the invention;

FIG. **2**, on a larger scale, represents a cross-section according to line II—II in FIG. **1**;

FIGS. **3** and **4** represent how two floor panels with coupling parts according to FIG. **2** match into each other;

FIG. **5**, on a larger scale, represents a cross-section according to line V—V in FIG. **1**;

FIGS. **6** and **7** represent how two floor panels with coupling parts according to FIG. **5** match into each other;

FIGS. **8** to **11** represent a number of variants of coupling parts of floor panels according to the invention;

FIG. **12** schematically represents how the floor parts can be provided with coupling parts;

FIG. **13** represents a cross-section according to line XIII—XIII in FIG. **12**;

FIGS. **14** to **21**, on a larger scale and in cross-section, represent the penetration of the milling cutters which are indicated in FIG. **12** with arrows F**14** to F**21**;

FIG. **22** represents a floor panel according to the invention;

FIG. **23**, on a larger scale, represents the coupling of two floor panels of FIG. **22**;

FIGS. **24** and **25** represent two manners of coupling floor panels according to FIG. **22** to each other.

DETAILED DESCRIPTION

The invention relates to a floor covering which is composed of hard floor panels **1**, for example, such as a laminated panel as shown in FIG. **1**.

These floor panels **1** can be of various shape, for example, rectangular or square, or of any other shape.

In the most preferred form of embodiment, they shall be manufactured in an elongated form, such as shown in FIG. **1**, for example, with a length of 1 to 2 meters. The thickness, however, can also vary, but is preferably 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel **1** is, at least at the edges of two opposite sides **2**–**3**, provided with coupling parts **4**–**5** which permit two adjacent identical floor panels **1** to be coupled to each other.

According to the invention, the coupling parts **4**–**5**, as represented in the FIGS. **2** to **4**, are provided with integrated mechanical locking parts or locking elements **6** which prevent the drifting or sliding apart of two coupled floor panels **1** in a direction D perpendicular to the respective sides **2**–**3** and parallel to the underside **7** of the coupled floor panels **1**; the coupling parts **4**–**5** and the locking elements **6** are formed in one piece with the core **8** of the floor panels **1**; the coupling parts **4**–**5** have such a shape that two subsequent floor panels **1** can be engaged into each other solely by snapping-together and/or turning after the coupling parts are partially engaged, whereby each subsequent floor panel **1** can be laterally inserted into the previous; and the coupling parts **4**–**5** preferably are interlocked free from play in all directions in a plane which is located perpendicular to the aforementioned edges.

In the case of floor panels **1** with an elongated shape, as represented in FIG. **1**, the respective coupling parts **4**–**5** are located at the longitudinal sides **2**–**3**.

The coupling parts **4**–**5** can be realized in various forms, although the basic forms thereof will always be formed by a tongue **9** and a groove **10**.

In the form of embodiment of FIGS. **2** to **4**, the related floor panel **1** is provided with coupling parts **4**–**5** and locking means or locking elements **6** which allow two floor panels **1** to be mutually engaged by means of a turning movement, without the occurrence of any snap-together effect.

In the represented example, the locking elements **6** consist of a first locking element **11**, formed by a protrusion with a bent round shape at the lower side **12** of the tongue **9**, and a second locking element **13** (shown in FIG. **2**), formed by a recess with a bent hollow or downwardly concave shape in the lower wall **14** of the groove **10**.

The locking elements **11**–**13** ensure that two floor panels **1** which are coupled to each other can not move laterally in the horizontal plane with respect to each other.

In order to enable two floor panels **1** to be inserted into each other by means of a turning movement, the curvatures preferably are circular. The bottom side **12** of locking means or locking elements **6** has a curvature with a radius R**1**, the center of which coincides with the respective upper edge **15** of the floor panel **1**, whereas the lower wall **14** of the locking part **5** has a curvature with a radius R**2** which is equal to the radius R**1**, but its center coincides with the respective upper edge **16**. Radii R**1** and R**2** may also be applied which are larger or smaller than the distance to the upper edge **15**, **16** respectively, and/or which differ from each other in size.

The upper side **17** of the tongue **9** and the upper wall or side **18** of the groove **10** are preferably flat and preferably are located in the horizontal plane.

The inner side **20** of the groove **10** and the front side **19** of the tongue **9** of the two interlocked floor panels **1** preferably do not fit closely against each other, such that an intermediate space or clearance **21** is created between them into which possible dust remainders or such can be pushed away by means of the tongue **9**.

The tongue **9** and the groove **10** preferably have shapes which are complementary to each other, such that the tongue **9** in the engaged condition of two identical floor panels **1** precisely sits against the upper wall **18** and the lower wall **14** of the groove **10**, whereby a pressure P, exerted against the upper lip **22**, is received or reacted not only by this lip **22**, but by the complete structure, because this pressure can be transmitted through the tongue **9** and the lower lip **23** to cause the panels to be urged towards each other.

It is, however, clear that a number of minor deviations to these complementary forms can occur which, anyhow, have no or almost no effect upon th receipt and transmission of pressure forces. For example, a chamfer **24** on lip **22** and a recess or clearance **25** can be provided, as represented in FIGS. **2** to **4**, as a result of which the subsequent floor panels **1** can easily be pushed and guided into each other, such that no possible ridges in the subflooring or such render good insertion difficult. The recess **25** defines a chamber **25'** (FIG. **4**) when the floor panels are coupled, the chamber **25** created between the tongue **9** and the upper edges **15**, **16**. The upper lip **22** of edge **3** engages the opposing panel edge **2** below upper edge **15** along a contact surface that is perpendicular to the plane of the coupled panels, as shown.

As represented in the FIGS. **5** to **7**, the floor panels **1** according to the invention can also, along the sides **26**–**27** which are at a right angle to the sides **2**–**3**, be provided with coupling parts **28**–**29** which have locking elements **30**, too. The coupling parts **28**–**29** are preferably also realized in the shape of a tongue **31** and a groove **32**. Hereby, the locking elements **30** do not have to be of the same nature as the locking elements **6**.

Preferably, at the sides **26**–**27** locking elements are provided which allow for an engagement and interlocking by means of a lateral translation movement in direction T only, as represented in FIGS. **6** and **7**. To this aim, the locking elements **30** consist of a snap-together connection with locking elements **33** and **34** which grip behind each other.

As represented in FIGS. **5** to **7**, the locking element **33** preferably consists of a protrusion of the lower side **35** of the tongue **31** which can be located in a recess **36** in a lower lip **43** extending distally from the lower wall **37** of the groove **32**. The locking element **34** is formed by the upward directed part or protrusion which defines the distally outer end of recess **36**.

In this case, the locking elements **33**–**34** have contact surfaces **38**–**39** which are parallel to each other and prefer-

ably extend in an inclined manner, according to a direction which simplifies the snapping-together of the panels. The common plane of tangency L which is determined by the common tangent at the meeting point or area of surfaces **38–39**, hereby forms an angle A sloping inwardly and downwardly from an outer region to an inner region relative to the underside **7**, which angle is smaller than 90°.

The locking elements **33–34** preferably are provided with inclined portions **40** and **41** which, when two floor panels **1** are engaged, cooperate with each other in such a manner that the locking elements **33–34** can easily be pushed over each other until they grip behind each other by means of a snap-together effect (FIGS. **6** and **7**).

The thickness W1 of the tongue **31** preferably is equal to the width W2 of the groove **32**, such that compression pressure P applied to the upper lip **42** is reacted by the tongue **31** which, in its turn, then is reacted by the lower lip **43**.

Analogous to the chamfer **24** and recess **25**, a recess or clearance **44** and a chamfer **45** are provided also at the edges **28–29**.

It is noted that such a snap-together coupling can also be applied at the edges **2–3**. Hereby, this can be a snap-together coupling analogous to these of FIGS. **5** to **7**, but this can also be a snap-together coupling using other forms of coupling configurations, for example, such as represented in FIGS. **8** and **9**. Contrary to the locking elements **33–34** which consist of rather local protrusions, in the forms of embodiment of FIGS. **8** and **9** use is made of locking elements **46–47** which, in comparison to the total width B of the coupling, extend over a rather large distance.

In this case, the locking elements **46–47** are also provided at the lower side **12** of the tongue **9** and the lower wall **14** of the groove **10**.

According to FIG. **8**, the locking elements **46–47** have contact surfaces **48–49** which are at a vertical angle with the plane of the floor panel **1**. In this manner, a coupling is obtained which is interlocked in a particularly fixed manner.

As represented in FIG. **9**, the locking elements **46–47** possibly can be configured in such a manner that substantially only a linear contact is obtained, for example, because the contact surfaces directed towards each other are formed with different curvatures.

The contact surfaces **48'**, **49'**, directed towards each other, of the locking elements **46–47** in this embodiment consist of curved surfaces. The common plane of tangency L forms an angle A which is smaller than 90°, and more preferably is smaller than 70°.

In this manner, the locking element **46** preferably has two portions with a different curvature, on one hand, a portion **50** with a strong curvature and, on the other hand, a portion **51** with a weak curvature. The portion **50** with the strong curvature provides for the formation of a firm coupling. The portion **51** with the weak curvature facilitates the coupling parts **4–5** to be brought into each other easily. The intermediate space S forms a chamber which offers space for dust and the like which, when engaging two floor panes **1**, inevitably infiltrates there. The chamber at intermediate space S, the chamber **25'** defined by recess **44**, and clearance **21** are or may be essentially independent clearances or chambers when the tongue and groove elements are coupled, as illustrated. It will be noted that the tongue **9** in FIGS. **9** and **10** has a cross-sectional periphery that defines the outer shape of the tongue in transverse cross-section. As illustrated, the tongue **9** includes an upper surface **9***a*, a lower surface **9***b* and a distalmost surface **9***c*, the outer form or profile of the tongue along and connecting these surfaces constituting a tongue periphery that includes an upper tongue contact surface **9***d* that engages an upper groove or lip contact surface **22***a* when panels are coupled as seen in FIG. **9** and a lower contact surface **48'** engaging the lower groove or lip contact surface **49'** intersecting the common plane of tangency L in this example.

As seen in FIGS. **5**, **6** and **7**, an intermediate lower tongue contact surface **31***a* engages intermediate lower groove, or lip contact surface **32***a* when the tongue **31** and groove **32** are coupled together. The intermediate contact surfaces are located along the periphery of tongue **31** and the surface of groove **32** between lower contact surfaces **38**, **39** and upper contact surfaces **85**, **86** between the tongue and groove elements.

In the case of a snap-together connection, for example, a connection such as represented in FIGS. **7** to **9**, preferably the tongue **9–31** has a shape that thickens from below, which then can cooperate with a widened portion in the groove **10**.

In FIG. **10**, a variant is represented whereby at least at the level of the upper edges **15–16**, a sealing material **52** is provided, as a result of which a watertight sealing can be assured. This sealing material **52** may consist of a strip or covering which is provided previously at the floor panel **1**, either at one or both upperside edges **15–16**.

In FIG. **11**, a further variant is represented, whereby the locking element **6** is formed by an upward directed portion **53** at the tongue **9**, which as a result of a turning movement of the panel, is brought behind a downward-directed portion **54** on the upper wall **18**. More particularly, this is obtained by forming the upper side **17** and the upper wall **18** with a curvature R3, the center of which is situated at the upperside edges **15–16**, and forming the lower side **12** and the lower wall **14** with a radius R4, the center of which is also situated at the upperside edges **15** and **16**, respectively. These radii R3–R4 can be chosen otherwise, too.

In general, according to the invention, the difference between, on one hand, the radius R1, R3 respectively, and, on the other hand, the radius R2, R4 respectively, preferably should not be larger than 2 mm.

It is also preferred that the center of these radii be situated inside the circle C1, C2 (see FIG. **2**) respectively, which extends with a radius R5 of 3 mm centered at upperside edge **15,16** respectively.

Finally is noted that, according to the invention, the lower lip **23–43**, as represented in FIGS. **2** to **7**, can be formed distally longer than the upper lip **22–42**. This has an advantage that the coupling parts **4–5–28–29** can be shaped in an easier manner by means of a milling cutter or the like. Furthermore, this simplifies the engagement of two floor panels **1**, because each subsequent floor panel **1** during installation can be placed upon the protruding lower lip **23–43**, as a result of which the tongue **9–31** and the groove **10–32** automatically are positioned in front of each other.

The embodiments wherein the lower lip **23** of the groove element is equal to or distally shorter than the upper lip **22**, in their turn, offer the advantage that no protruding lip **23** remains at the extreme edge of the floor which might cause problems in finishing the floor installation.

In order to allow for a smooth assembly, to guarantee the necessary stability and firmness and in order to limit the quantity of material to be cut away, the difference E between the distally outer edge of the upper lip **22–42** and the distally outer edge of the lower lip **23–43**, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove **10**, should preferably be kept smaller than

one time the total thickness F of the floor panel **1**. For stability's sake, normally this total thickness F shall never be less than 5 mm.

The small dimension of the difference E offers the advantage that the lower lip need not be strengthened by a reinforcement strip or the like.

According to a particular form of embodiment, the central line Ml through the tongue **9** and the groove **10** is situated lower than the center line M2 of the floor panel **1**, such, that the upper lip **22–42** is thicker than the lower lip **23–43**. In first instance, this is essential in this kind of connection, because then it is the lower lip **23–43** which bends, whereby the upper side of the floor panel **1** is kept free of possible deformations.

As explained in the introduction, for the core **8** a material is chosen from the following series:

a. a ground product which, by means of a binding agent or by means of melting together is made into a unitary composite material;

a product based on synthetic material;

chip board with fine chips.

The invention shows its usefulness, in first instance, preferably with laminated flooring, due to the reasons explained in the introduction.

As represented in the examples of the FIGS. **2** to **11**, such laminated flooring preferably consists of a core **8** made of MDF medium density fiberboard board, HDF high density fiberboard board or similar, whereby at least at the upper side of this core **8** one or more layers of material are provided.

More particularly, it is preferred that the laminated flooring is provided with a decorative layer **55** and a protective top layer **56**. The decorative layer **55** is a layer, impregnated with resin, for example, made of paper, which can be imprinted with a variety of patterns, such as a wood pattern, a pattern in the form of stone, cork, or similar or even with a fancy pattern. The protective top layer **56** preferably also consists of a layer saturated with resin, for example, melamine resin, which in the final product is transparent.

It is clear that still other layers can be applied, such as an intermediate layer **57** upon which the decorative layer **55** is provided.

Preferably, also a backing layer **58** shall be applied at the underside **7**, forming a counterbalancing element for the top layers and, thus, guaranteeing the stability of the form of the floor panel **1**. This backing layer **58** may consist of a material, for example paper, impregnated with a resin, for example, a melamine resin.

As represented schematically in FIG. **12**, the tongue **9** and the groove **10**, and preferably also the tongue **31** and the groove **32** are formed by means of a milling process. In the case that a profile has to be applied on all four sides, the floor panels **1** preferably shall be displaced by means of two sequential perpendicular movements V1 and V2, whereby during the first movement profiles at two opposite edges are provided, in this case the longitudinal edges, by means of milling devices **59–60**, whereas during the second movement profiles are provided at the other edges, in this case the small edges, by means of milling devices **61–62**. During these processing, the floor panels **1** preferably are put with their decorative layer directed downward.

According to an important characteristic of the invention, each respective tongue **9–31** and groove **10–32** are formed by means of a milling process with at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in reference to the related floor panel **1**.

This is illustrated in FIGS. **13**, **14** and **15**, wherein it is represented how a groove **10** is realized by means of two milling cycles by means of two milling cutters **63** and **64**. FIGS. **16** and **17** represent how the cross section periphery of tongue **9** is shaped by means of milling cutters **65** and **66**.

The FIGS. **18–19** and **20–21** represent similar views showing how the groove **32** and the cross-section periphery of tongue **31** are shaped by means of milling cutters **67–68** and **69–70**, positioned at angle.

During each of the aforementioned milling passes, substantially the final shape of one flank is fully realized. For example, the milling cutter **63** of FIG. **14** determines the final shape of the lower flank **71** of the groove **10**, whereas the milling cutter **64** determines the final shape of the upper flank **72**.

As mentioned in the introduction, preferably milling cutters **63** to **72** shall be used, having diameters G which are at least 5 times, and even better at least 20 times larger than the thickness F of the floor panels **1**.

Apart of the mentioned milling cutters, preferably still other milling cutters are applied, for example, in order to remove a part of the material to be removed during a first premachining cycle.

In the FIGS. **22** to **25**, a particularly preferred form of embodiment of a floor panel **1** according to the invention is represented. Hereby, the parts which correspond with the previous embodiments are indicated with corresponding references.

An important characteristic herein consists in that the coupling parts **4–5** are provided with locking elements **6** which, in engaged condition with the panels in a common plane, exert a tension force upon each other, as a result of which the engaged floor panels **1** are forced towards each other in compression. As represented, this is realized preferably by providing the coupling parts with an elastically yieldable or bendable portion, in this case the lower lip **43**, which, in engaged condition, is at least partially bent and in this way creates a tension force which results in the engaged floor panels **1** being forced towards each other. The resultant bending V, as well as the tension force K, are indicated in the enlargement view of FIG. **23**.

In order to obtain the tension force K pressing together the engaged floor panels **1**, the bendable portion, in this case the lip **43**, preferably is provided, as represented, with an inwardly and downwardly inclined lower lip contact surface **73** which preferably can cooperate with a corresponding lower tongue contact surface **74** on tongue **9**. These contact surfaces **73–74** are similar to the aforementioned contact surfaces **39–38** and also similar to the inclined portions of the lower lip of FIGS. **2** to **4**.

In the FIGS. **2** and **5**, the portions form complementary matching shapes; it is, however, clear that, by a modification, also a tension effect similar to that shown in FIG. **23** can be realized.

Due to, on one hand, the contact along the angle A, and, on the other hand, the fact that a tension force K is created, a compression force component K1 is produced, as a result of which the floor panels **1** are drawn against each other in compression.

Preferably, the angle A of the mutual plane of tangency of contact surfaces **73–74** relative to the horizontal plane is situated between 30 and 70 degrees. In the case that use is made of the embodiment whereby a tension force K is realized, an angle A of 30 to 70 degrees is ideal in order, on one hand, to effect an optimum pressing–together of the floor panels **1** and, on the other hand, to ensure that the floor panels **1** can easily be engaged and respectively disassembled.

Although the pressing or compression force component K1 preferably is delivered by the aforementioned lip **43**, the invention does not exclude other forms of locking elements or structures whereby this force is delivered by other bendable portions.

It is noted that the bending V is relatively small, for example, several hundredths up to several tenths of a millimeter, and does not have an influence upon the placement of the floor covering. Furthermore it should be noted that such floor covering generally is placed upon an underlayer (not shown) which is elastically compressible, as a result of which the bending V of the lip **43** only produces local bending of the underlayer.

Due to the fact that the lip **43** is bent apart and that it remains somewhat bent apart in engaged position, the additional advantage is obtained that, when exerting a pressure upon the floor covering, for example, when placing an object thereupon, the pressing–together compressive force is enhanced and, thus, the development of gaps is counteracted even more.

It is noted that the inventors have found that, contrary to all expectations, an ideal tension force can be realized by manufacturing the coupling parts **4–5**, including the locking elements **33–34**, and preferably the complete core **8**, of HDF board or MDF board, although these material normally only allow a minor elastic deformation.

HDF and MDF also offer the advantage that smooth surfaces are obtained, as a result of which the locking elements can be moved easily over each other.

According to a variant of the invention, the tension force can also be supplied by means of an elastic compression of the material of the coupling parts themselves, to which end these coupling parts, and preferably the complete core **8**, would be manufactured using an elastically compressible material.

A further particular characteristic of the embodiment of FIGS. **22** to **25** consists in that the floor panels **1** can be selectively engaged by means of a turning movement, as represented in FIG. **24**, as well as by means of laterally shifting them towards each other in substantially a common plane, as represented in FIG. **25**, preferably in such a manner that, during the engagement by means of the turning movement with the coupling parts partially engaged, a maximum bending Vm results in the coupling parts, more particularly in the lip **43**, which bending Vm is less pronounced, if not nonexistent, as in the FIGS. **2** to **4**, in comparison to the bending Vm which results when the floor panels **1** are engaged by means of shifting them towards each other, as in FIG. **15**.

The advantage of this consists in that the floor panels **1** can be engaged easily by means of a turning movement, without necessitating use of a tool therefore, whereas it still remains possible to engage the floor panels also by means of shifting them laterally. This latter is useful, in first instance, when the last panel has to be placed partially under a door frame or similar situation. In this case, the floor panel **1** can be pushed under the door frame with the side which does not have to be engaged and subsequently, possibly by means of tools, can be snapped into the adjacent floor panel by lateral sliding together.

It is noted that the shapes of the coupling parts **4–5** shown in FIGS. **22** to **25** can also be used for the coupling parts **28–29** of the short sides of the panels.

According to the invention, in the case that the four sides **2–3–26–27** are provided with coupling pars **4–5–28–29**, these coupling parts can be formed in such a manner that in one direction a firmer engagement than in the other direction is effected. In the case of elongated floor panels **1**, for example, such as represented in FIG. **1**, the locking at the small sides **26–27** preferably shall be more pronounced than at the longitudinal sides **2–3**. The length of the parts at the small sides, namely, is smaller and, in principle, less firm. This is compensated for by providing a more pronounced locking.

This difference in engagement can be obtained by shaping the contact surfaces **73–74** with different angles.

Preferably, the aforementioned protrusion, more particularly the locking element **33**, is bounded by at least two portions **75–76** (shown in FIG. **22**), respectively a portion **75** with a strong (steep) inclination which provides for the locking, and a portion **76** with a weaker (less inclined) inclination which renders the engagement or guidance of the coupling parts easier. In the embodiment of FIGS. **22** to **25**, these portions **75–76** are formed by straight planes to define local sharp protrusions, but as already described with reference to FIG. **9**, use can also be made of curved portions **50–51**. In FIG. **5**, these are the contact surface **38** and the inclined portion **40**.

In the preferred form of the invention, the floor panels **1** comprise coupling parts **4–5** and/or **28–29** exhibiting one of the following or the combination of two or more of the following features:

- a curvature **77** (shown in FIG. **22**) at the lower side of the tongue **9** and/or a curvature **78** at the lower lip **43** which form a guidance when turning two floor panels **1** into each other, with the advantage that the floor panels **1** can be engaged into each other easily during installation;
- roundings **79–80** at the edges of the locking elements **33–34**, with the advantages that the locking elements can easily shift over each other during their engagement, or during disassembly of the floor panels **1** and that the locking elements will not be damaged, for example, crumble away at their edges, even if the floor panels are engaged and disassembled;
- dust chambers or clearances **81**, or spaces **21** as in FIG. , or chamber **25'** in FIG. **4**, or spaces S in FIG. **9**, between all sides, directed laterally towards each other, of the engaged floor panels **1**, with the advantage that inclusions which get between the floor panels **1** during the engagement do not exert an adverse influence upon good engagement;
- a shaping of the tongue **9** which is such, for example, by the presence of a chamfer **82**, that the upper side of the tongue **9** becomes situated from the first joining together or substantial contact of the panels, under the lower side of the upper lip **42** when the floor panels **1** are pushed towards each other in substantially the same plane, as indicated in FIG. **25**, with the advantage that the front extremity or end of the tongue **9** does not press against the front side of the upper lip **42** or the front edge of the bottom lip **43** when the floor panels are pushed towards each other in the same plane;
- a ramp surface **83**, hereinbefore also called inclined portion **41**, formed at the distally outer end of the lower lip **43**, with the advantage that the locking elements **33–34** shift smoothly over each other and that the lower lip **43** is bent uniformly;
- in the engagement direction only one important contact point which is formed by a section **84** at the location of the upperside edges of the floor panels **1**, with the advantage that the aforementioned tension force is optimally transferred to the upper side of the floor

panels **1** and that the development of openings between the floor panels **1** is counteracted;

contact surfaces **85–86**, more particularly abutment surfaces, formed by the upper side of the tongue **9** and the upper side of the groove **10** which, over the largest portion of their length, are flat and run parallel to the plane which is defined by the floor panels **1**, as well as contact surfaces cooperating with each other, formed by curvatures **77–78**, with the advantage that no mutual displacement in height between two engaged floor panels **1** is possible, even if the insertion depth of the tongue **9** into the groove **10** should vary due to various causes; in other words, no height differences may occur between the adjacent floor panels.

In the embodiment of FIGS. **22** to **25**, all these characteristics are combined; it is, however, clear that, as becomes evident from FIGS. **2** to **11**, these features can also be provided separately or in a limited combination with one another.

As becomes evident from FIGS. **5** to **7** and **22** to **25**, an important characteristic of the preferred embodiment of the invention consists in that the cooperative locking element **6**, in otherwords, the portion providing for the snap-together and engagement effect, are situated in that portion of the lower lip **23–43** which extend beyond the distal edge of the upper lip **22–42**, more particularly, the lowermost point or apex **87** of the locking part **33** is situated under the top layer of the floor panel **1**. For clarity's sake, this top layer is indicated in the FIGS. **22–25** only as a single layer.

It should be noted that the combination of features, the lower lip **23–43** extending further than the upper lip **22–42**; the locking elements **6** being formed at least by means of a contact surface portion which inwardly slopes downward, and wherein this portion, at least partially, is located in the portion of the lower lip **23–43** which extends distally beyond the upper lip **22–42**, is particularly advantageous, among others, in comparison with the couplings for floor panels described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The sloping contact surface portion offers the advantage that the floor panels **1** can be disassembled again. The fact that this sloping portion is situated in the extended portion of the lower lip **23–43** adds the advantage that no deformations can occur during coupling which manifest themselves up to the top layer.

According to a preferred characteristic of the invention, the aforementioned portion, i.e. the contact surface **39** or **73**, preferably extends in such a manner that the distance between the upper edge **16** of the panel to the contact surface **39**, **73** diminishes between the proximal and distal ends of the sloping contact surface **39**, **73**, in other words, such that, as represented in FIG. **22**, the distance X**2** is smaller than the distance X**1**. This is also the case in FIG. **7**.

Still preferably, this portion only starts at a clear distance El from the outer edge of upper lip **42**.

It is obvious that the coupling parts **22** to **25** can also be shaped by means of said milling process.

According to a particular characteristic of the invention, the floor panels **1** are treated at their sides **2–3** and/or **26–27** with a surface densifying agent, more particularly a surface hardening agent, which preferably is chosen from the following series of products: impregnation agents, pore-sealing agents, lacquers, resins, oils, paraffins and the like.

In FIG. **22**, such impregnation **88** is represented schematically. This treatment can be performed over the complete surface of the sides **2–3** and/or **26–27** or only over specific portions hereof, for example exclusively on the surfaces of the tongue **9** and the groove **10**.

The treatment with a surface densifying agent offers, in combination with the snap-together effect, the advantage that in various aspects better coupling characteristics are obtained. As a result of this, the coupling parts **4–5** and/or **28–29** better keep their shape and strength, even if the floor panels **1** are engaged and disassembled repeatedly. In particular, if the core **8** is made of HDF, MDF or similar materials, by means of this treatment a better quality of surface condition is obtained, such that no abrasion of material occurs during engaging, or during disassembling.

This treatment also offers the advantage that, at least in the case of a surface hardening, the aforementioned elastic tensioning effect is enhanced.

The present invention is in no way limited to the forms of embodiment described by way of example and represented in the figures, however, such floor covering and the pertaining floor panels **1** can be embodied in various forms and dimensions without departing from the scope of the invention.

For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other.

Furthermore, all embodiments of coupling elements described before can be applied at the longer side as well as at the shorter side of a panel.

What is claimed is:

1. A floor covering panel comprising laminated hard floor panel having a wood-based core material comprising a ground wood product and a binding agent unified to form a cured composite;

said floor panel having a decorative layer above said core material;

said floor panel having an upper side, an under side and a perimeter defining first and second pairs of opposed substantially parallel sides;

said first and second pairs of sides both being provided with coupling parts substantially in the form of a tongue and a groove the coupling parts further including locking elements;

said groove of at least said first pair of sides including an upper lip and a lower lip, said lower lip extending distally beyond the upper lip;

said coupling parts cooperating to establish a locking between coupled parts in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the side edges and parallel to a plane including the panel when the coupling parts of a plurality of ones of said panel are coupled;

said tongue, groove and locking elements being monolithically formed in said composite core;

said coupling parts and locking elements of at least said first pair of sides enabling coupling of two of such panels so that the panels are coupled without play in the plane of the coupled panels;

the coupling parts of said first pair of sides being engageable and coupled by rotational motion relative to each other;

said tongue of said first pair of sides including an upper tongue contact surface and a lower tongue contact surface and an outer peripheral portion of the tongue defined along and between said tongue contact surfaces;

said groove of said first pair of sides including corresponding upper and lower groove contact surfaces which engage the upper and lower tongue contact surfaces of said tongue upon coupling of said coupling parts;

said lower tongue and groove contact surfaces comprising said coupling parts and locking elements enabling coupling of two of such panels so that the panels are coupled without play in a plane including the coupled panels;

said coupling parts of said first pair of sides upon coupling defining a plurality of separate clearances adjacent at least a portion of said outer peripheral portion of said tongue between said groove and said tongue;

said panel at said first pair of sides comprising at least one intermediate tongue contact surface on said tongue positioned along the outer peripheral portion of said tongue intermediate the upper and lower tongue contact surfaces;

said panel at said first pair of sides comprising at least one intermediate groove contact surface intermediate the upper and lower groove contact surfaces; and

said intermediate tongue and groove contact surfaces of two of said panels cooperating with each other upon coupling of two of said panels.

2. The floor panel according to claim **1**, wherein said intermediate contact surface on said groove is disposed proximally relative to a distalmost portion of said upper lip.

3. The floor covering according to claim **1**, wherein at least one clearance is defined by said engaged tongue and groove in an area between the respective intermediate tongue and groove contact surfaces and the lower tongue and groove contact surfaces of said engaged tongue and groove.

4. The floor covering panel according to claim **1**, wherein the coupling parts of said second pair of sides are engageable and coupled by rotational motion relative to each other about an axis extending parallel to said sides.

5. The floor covering panel according to claim **1**, wherein the cured composite core comprises MDF/HDF.

6. The floor covering according to claim **1**, wherein the locking elements include a locking protrusion defined on the tongue and a cooperating recess defined in the groove.

7. The floor covering panel according to claim **6**, wherein the locking protrusion is defined on an under side of said tongue.

8. The floor covering panel according to claim **6**, wherein the locking protrusion is in the form of a local sharp protrusion on the under side of said tongue.

9. The floor covering panel according to claim **6**, wherein the cooperating recess formed in the lower lip defines a portion of a clearance between the tongue and the groove that is established when the coupling parts are coupled.

10. The floor covering panel according to claim **7**, wherein the locking protrusion provided in the under side of the tongue extends substantially downward from the under side of the tongue and the recess defined in the groove is aligned with the locking protrusion when the coupling parts are coupled.

11. The floor covering panel according to claim **1**, wherein the lower lip has a cross-section configuration uniform along the length of the respective edge including the lower lip and has a non-uniform thickness between upper and under sides thereof.

12. The floor covering panel according to claim **11**, wherein the lower lip has a thickness adjacent a proximal inner portion of the groove that becomes non-uniformly thinner in the distal direction of the lip.

13. A floor covering panel comprising hard floor panel having a perimeter defining at least a first pair of opposed substantially parallel edges and substantially planar and parallel upper and lower sides;

said pair of edges being provided with complementary coupling parts substantially in the form of a tongue and groove extending distally along the length of said pair of edges and being formed in the panel material which is located between said planar upper and lower sides;

the coupling parts further including locking elements;

said coupling parts and locking elements cooperating upon coupling of said coupling parts such that coupled ones of said panel are locked in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the edges and parallel to a plane including the panel;

said groove having an upper lip and a lower lip, said lower lip extending distally beyond said upper lip:

said upper lip defining a first clearance below said upper side of said panel and defining an upper lip contact surface adjacent said clearance, said first clearance defining an upper chamber below said upper side and above said tongue upon coupling of cooperating coupling parts;

said lower lip having an inwardly and downwardly inclined lower lip contact surface formed therein;

said tongue having an upper tongue contact surface and a lower tongue contact surface located along the tongue periphery such that the upper and lower tongue contact surfaces respectively abut the upper and lower lip contact surfaces when adjacent panels are coupled; and

at least one second chamber being defined between the tongue and groove in the area along the tongue periphery between the respective upper tongue contact surface and the lower tongue contact surface when adjacent panels are coupled.

14. The floor covering panel according to **13**, wherein the tongue and groove may be coupled to each other by rotating one coupling part relative to another cooperating coupling part about an axis extending parallel to the respective coupled edges.

15. The floor covering panel according to claim **13**, wherein said first clearance is a closed chamber bounded on a lower side by abutting upper lip and upper tongue contact surfaces upon coupling of said coupled parts.

16. The floor covering panel according to claim **15**, said upper lip contact surface extending along the panel edge and parallel to the plane of the panel.

17. The floor covering panel according to claim **13**, wherein said floor panel is a laminate including an MDF/HDF core.

18. The floor covering panel according to claim **13**, wherein said tongue, groove and locking elements of at least said first pair of edges enable two of such panels to be coupled to each other without play in the plane of the coupled panels.

19. The floor covering panel according to claim **13**, wherein said second chamber is located in front of the distal end of the tongue tip.

20. The floor covering panel according to claim **13**, wherein said locking elements include a locking protrusion at the lower side of the tongue, said second chamber being located below said tongue and in front of said locking protrusion.

21. The floor covering panel according to claim **13**, wherein the panel is a laminate and includes a core, and said coupling parts as well as said locking elements are made in one piece with said core.

22. The floor covering panel according to claim **13**, wherein the locking elements include a locking protrusion at

the lower side of the tongue, said protrusion having a convex rounded bottom profile.

23. The floor covering panel according to claim **13**, wherein the locking elements include a locking protrusion at the lower side of the tongue, said protrusion having a convex rounded profile and a recess in the lower lip, said recess having a concave rounded profile.

24. The floor covering panel according to claim **23**, wherein said rounded profiles are substantially circle-shaped.

25. The floor covering panel according to claim **23**, wherein said lower lip contact surface and said lower tongue contact surface comprise said locking elements.

26. The floor covering panel according to claim **23**, wherein said locking protrusion, seen in cross-section, extends over a substantial portion of the lower side of the tongue.

27. A floor covering panel for forming a floating floor:

said floor panel having a core material and a decorative layer material above said core material;

said floor having a thickness between 0.5 and 1.5 cm;

said floor panel having an upper side, an under side and a perimeter defining first and second pairs of opposed substantially parallel sides;

said first and second pairs of sides both being provided with coupling parts, the coupling parts further including locking elements;

said groove of at least said first pair of sides including an upper lip and a lower lip, said lower lip extending distally beyond the upper lip;

said coupling parts of at least said first pair of side cooperating to establish a locking between coupled parts in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the side edges and parallel to a plane including the panel when the coupling parts of a plurality of ones said panel are coupled;

said tongue, groove and locking elements or said first pair of sides being formed in one piece with the panel, the coupling parts of said first pair of sides being engageable and coupled by rotational motion relative to each other;

said locking elements of at least said first pair of sides including a locking protrusion defined on the tongue and a cooperating recess defined in the groove;

said locking protrusion being in the form of a local sharp protrusion on the under side of said tongue;

said protrusion in one direction laterally being delimited by a first surface, said first surface acting as a locking element preventing relative movement between coupled panels in a direction parallel to a plane including the coupled panels;

said protrusion, in the opposite direction being limited by a second surface; and

said tongue and groove defining a clearance which is located directly adjacent said second surface and below the tongue portion which is located distally beyond said protrusion.

28. The floor covering panel according to claim **27**, wherein the core material is MDF or HDF.

29. The floor covering panel according to claim **27**, wherein said coupling parts of said at least first pair of sides are configured so that when coupled they are free of play.

* * * * *

EXHIBIT E

US006490836B1

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

(10) **Patent No.: US 6,490,836 B1**
(45) **Date of Patent: *Dec. 10, 2002**

(54) **FLOOR PANEL WITH EDGE CONNECTORS**

(75) Inventors: **Stefan Simon Gustaaf Moriau**, Ghent (BE); **Mark Gaston Maurits Cappelle**, Staden (BE); **Bernard Paul Joseph Thiers**, Oostrozebeke (BE)

(73) Assignee: **Unilin Beheer B.V. Besloten Vennootschap**, Nieuwerkerk A/D Ijssel (NL)

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/471,014**

(22) Filed: **Dec. 23, 1999**

Related U.S. Application Data

(63) Continuation of application No. 08/872,044, filed on Jun. 10, 1997, now Pat. No. 6,006,486.

(30) **Foreign Application Priority Data**

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Apr. 15, 1997 (BE) 09700344

(51) **Int. Cl.**[7] **E04B 2/08**
(52) **U.S. Cl.** **52/589.1**; 52/592.1; 52/586.1; 52/590.2; 52/592.3
(58) **Field of Search** 52/578.1, 589.1, 52/592.1, 590.2, 592.7, 586.1, 570, 572, 591.1, 590.1

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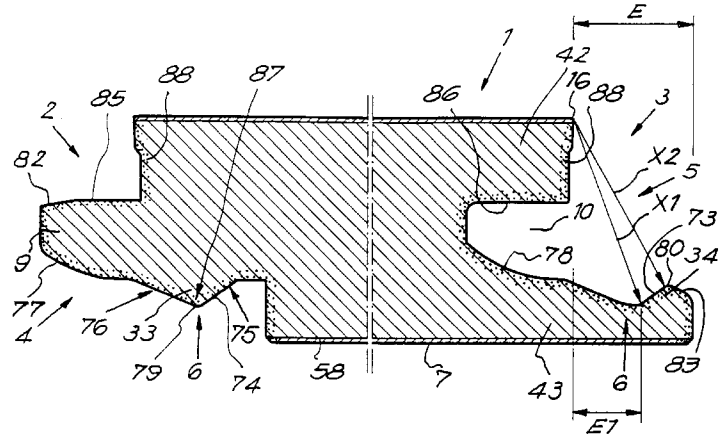
Primary Examiner—Yvonne M. Horton
(74) *Attorney, Agent, or Firm*—Bacon & Thomas

(57) **ABSTRACT**

Floor covering, including hard floor panels **(1)** which, at least at the edges of two opposite sides **(2–3, 26–27)**, are provided with coupling parts **(4–5, 28–29)**, cooperating which each other, substantially in the form of a tongue **(9–31)** and a groove **(10–32)**, wherein the coupling parts **(4–5, 28–29)** are provided with integrated mechanical locking elements **(6)** which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges **(2–3, 26–27)** and parallel to the underside **(7)** of the coupled floor panels **(1)**.

30 Claims, 10 Drawing Sheets



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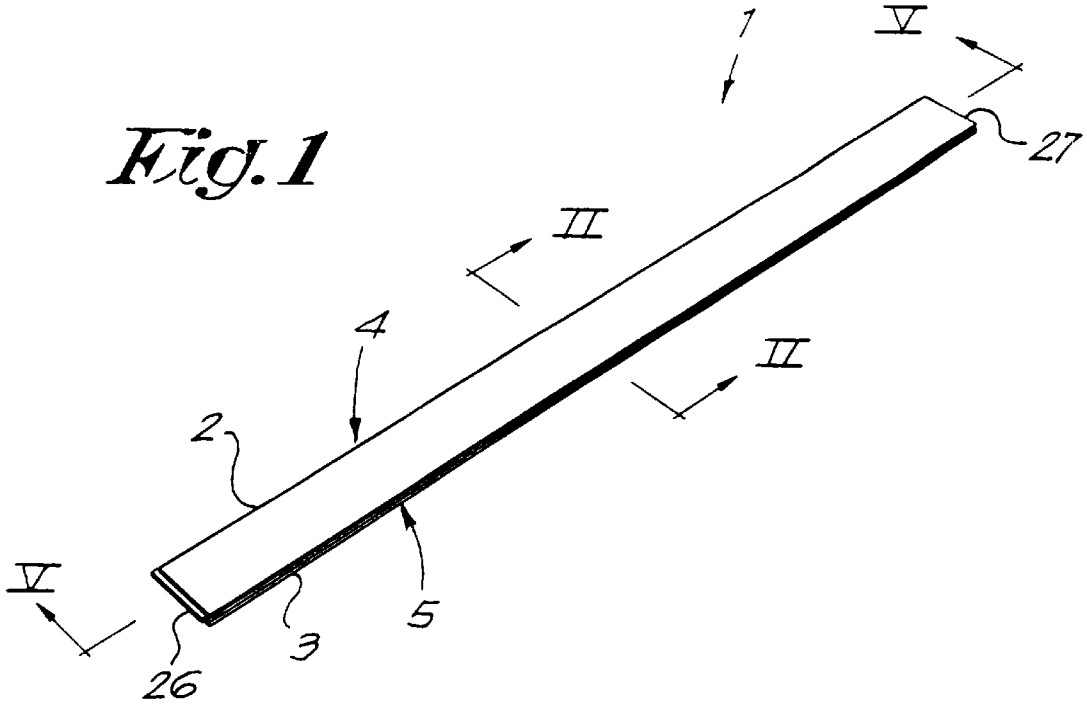
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Fig. 1

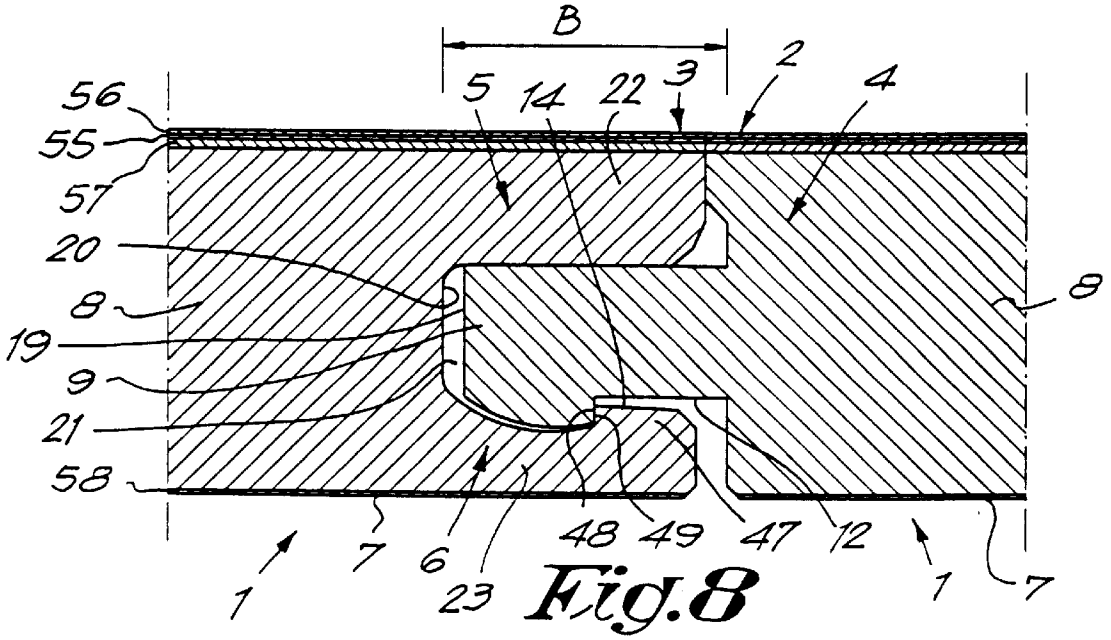
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Fig. 8

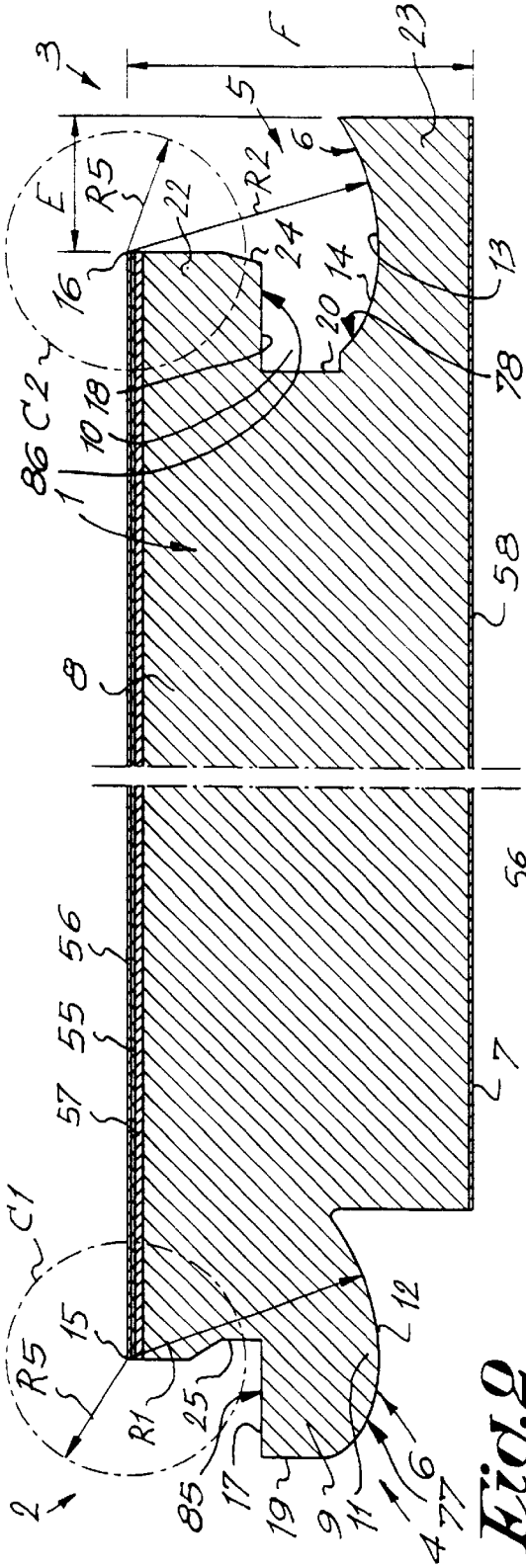

Fig. 2

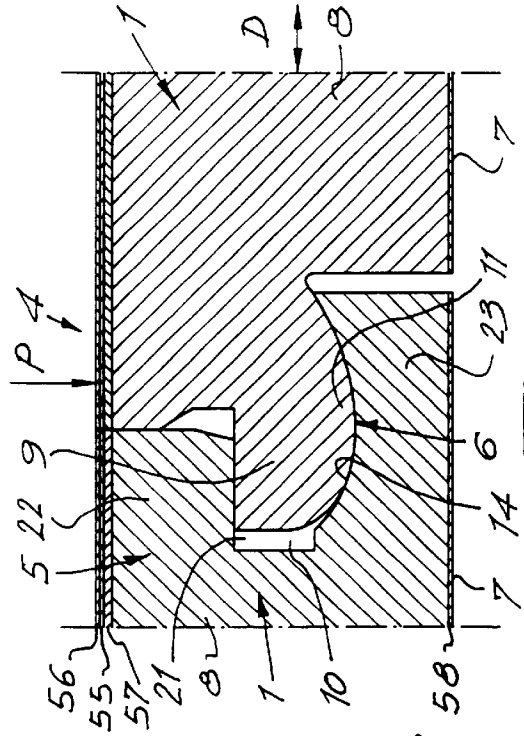

Fig. 4

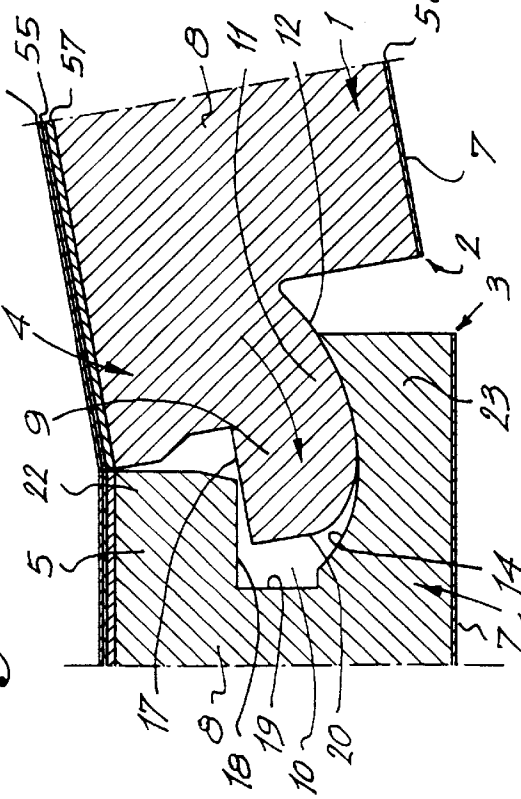

Fig. 3

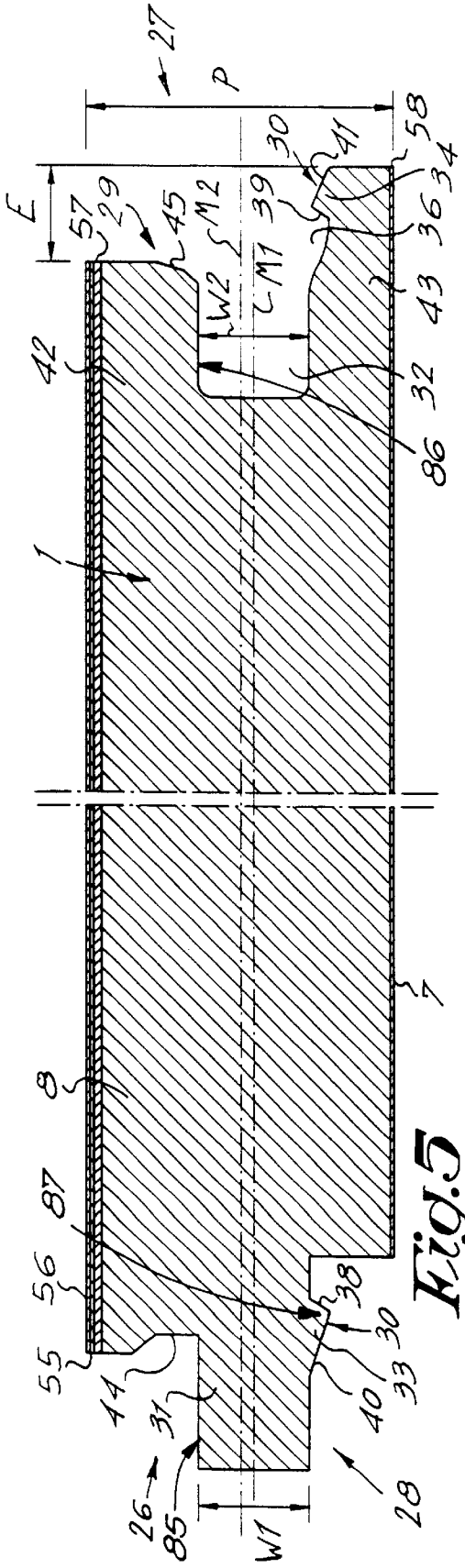

Fig.5

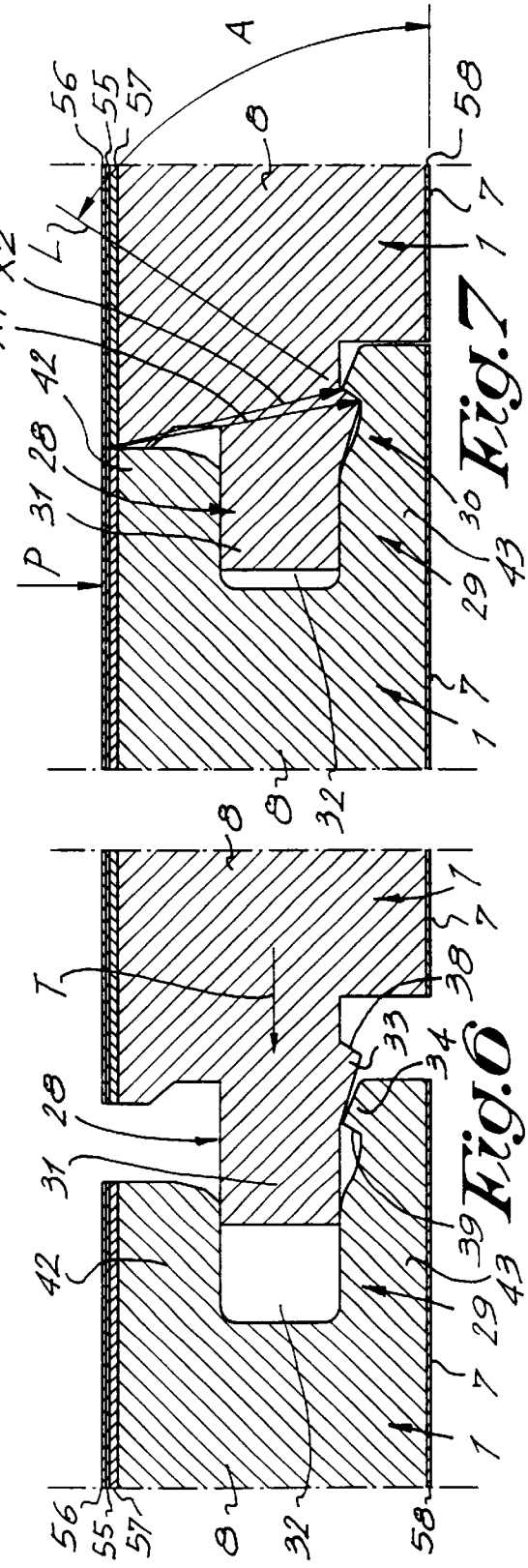

Fig.7

Fig.6

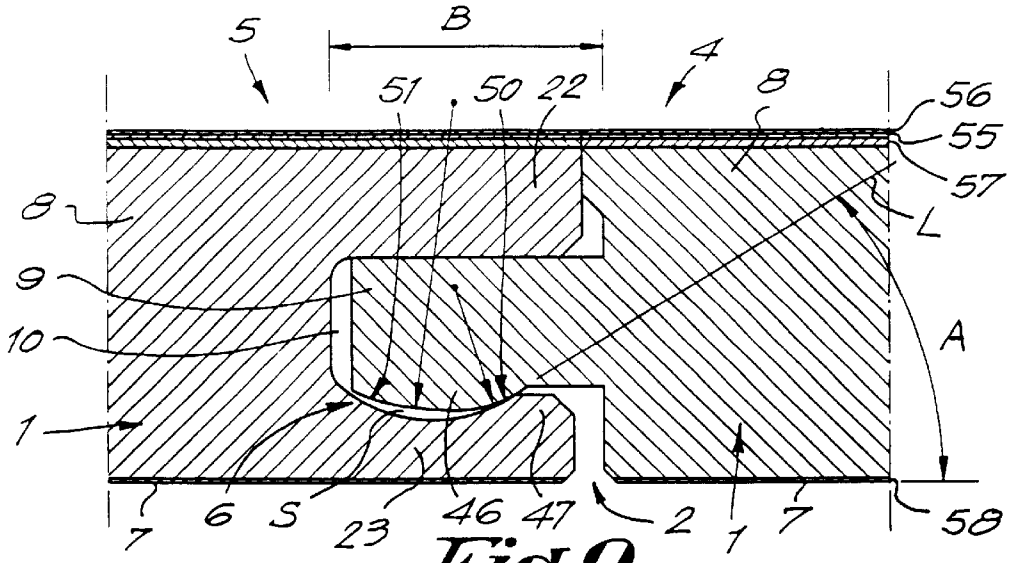

Fig.9

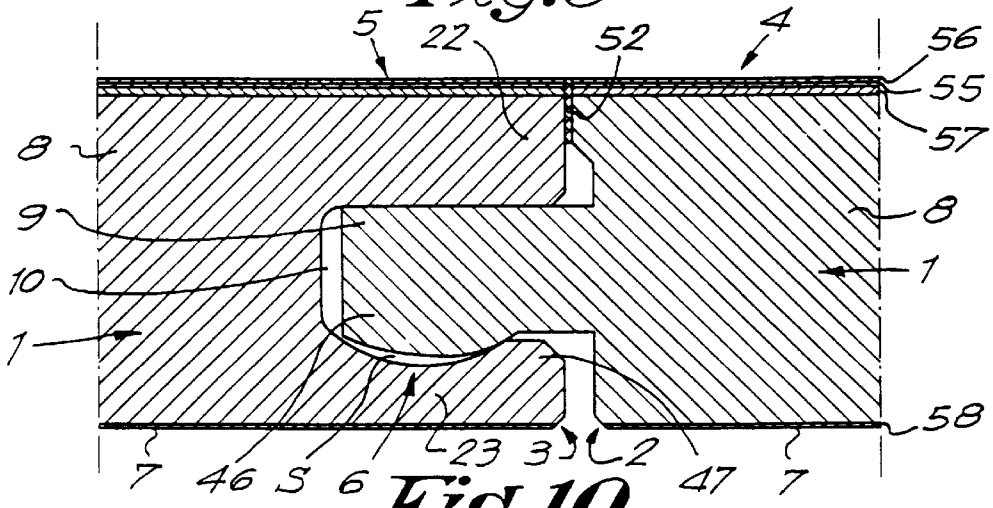

Fig.10

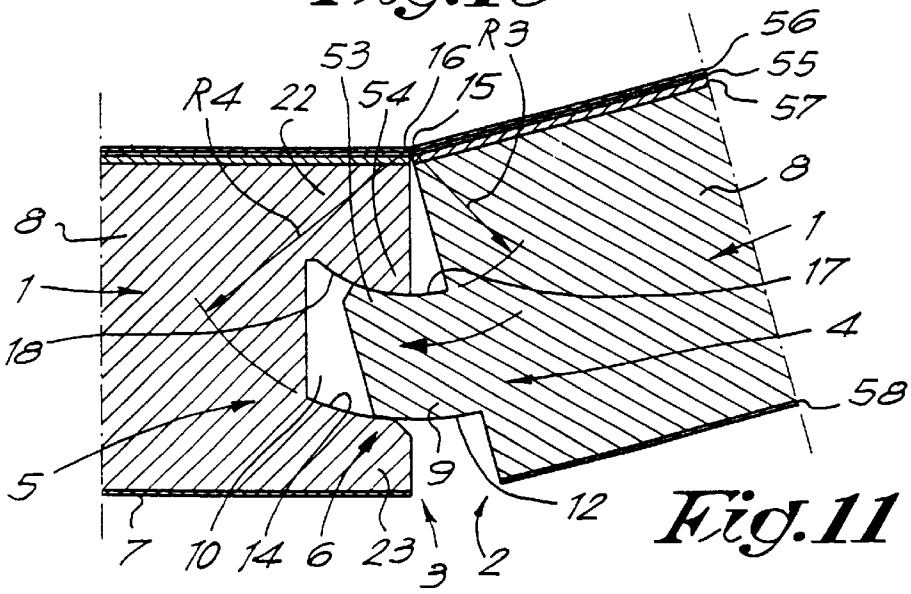

Fig.11

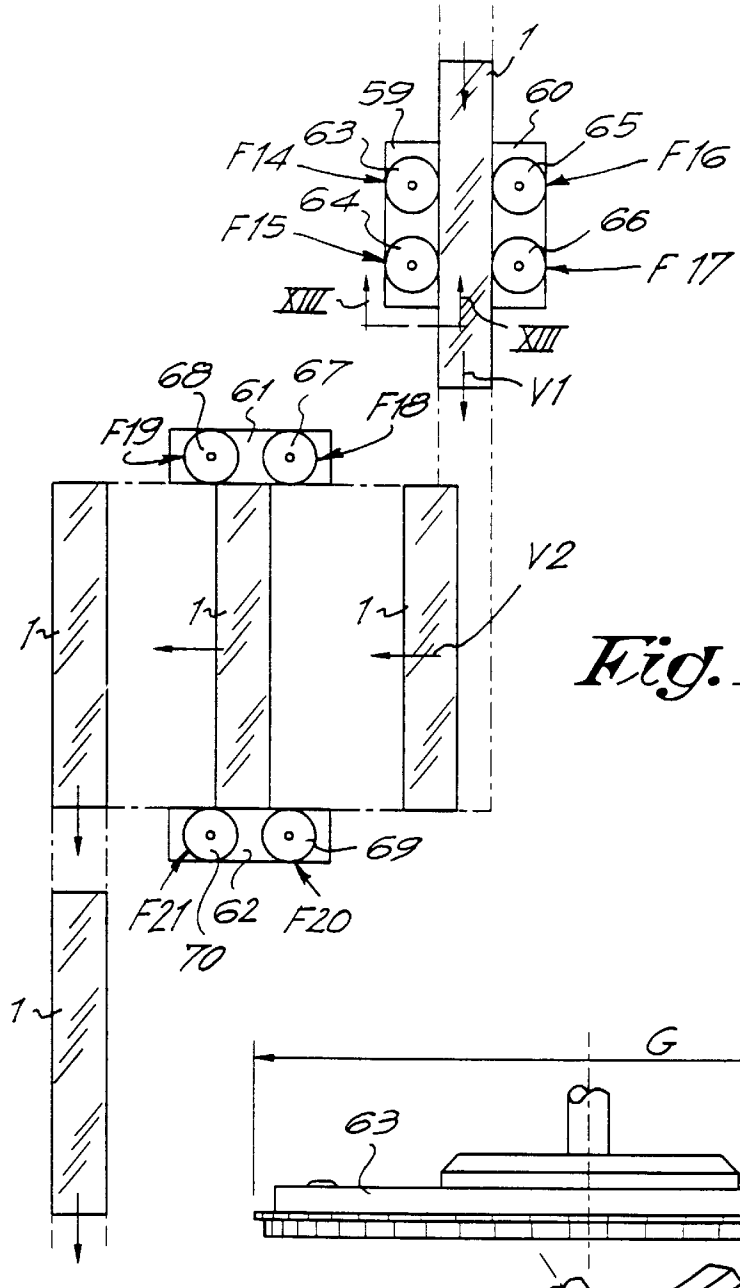
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Fig. 12

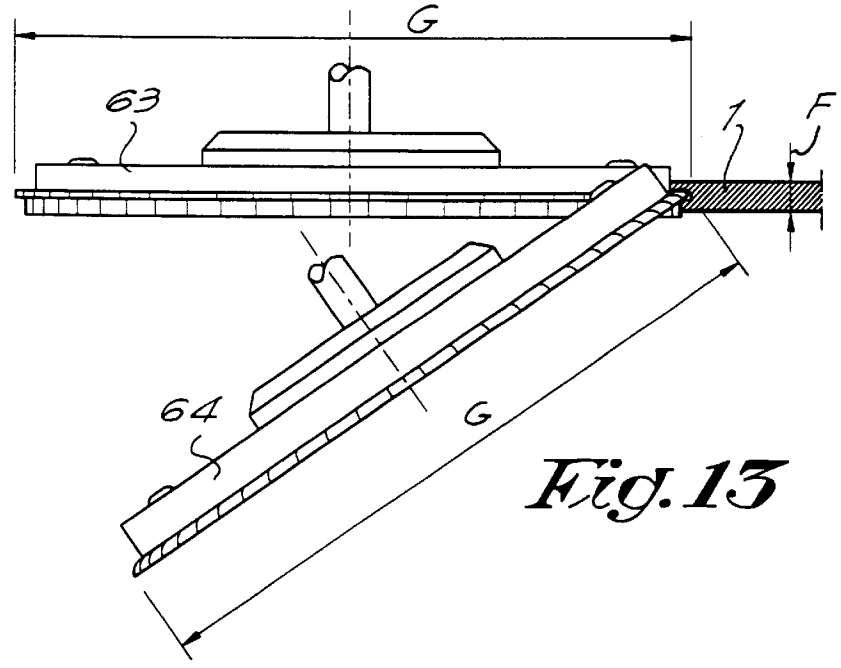
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Fig. 13

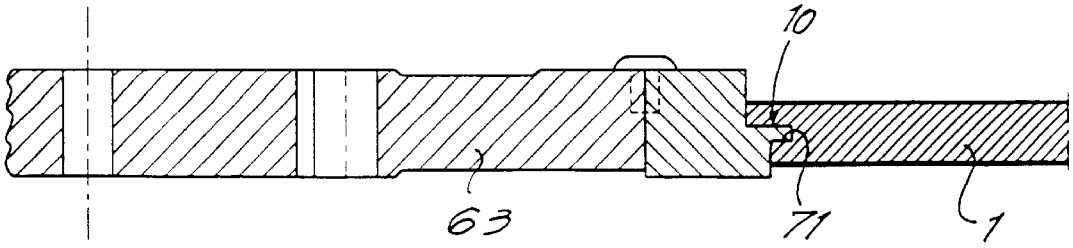


Fig. 14

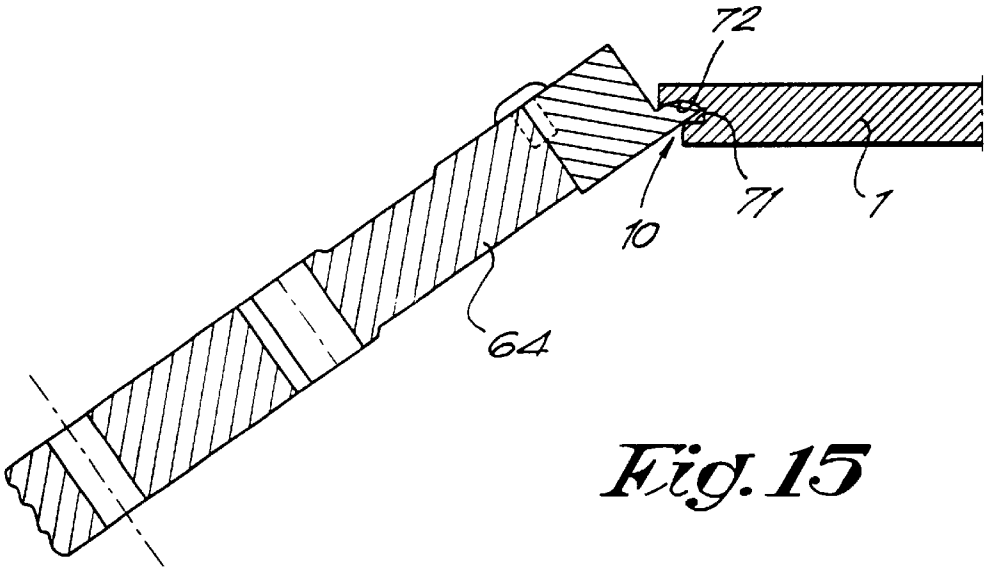


Fig. 15

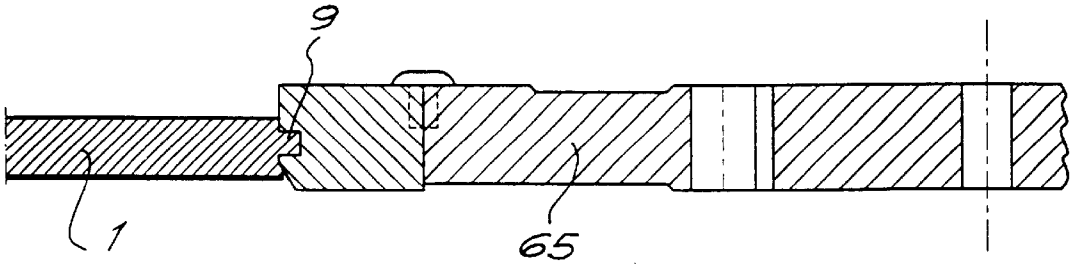
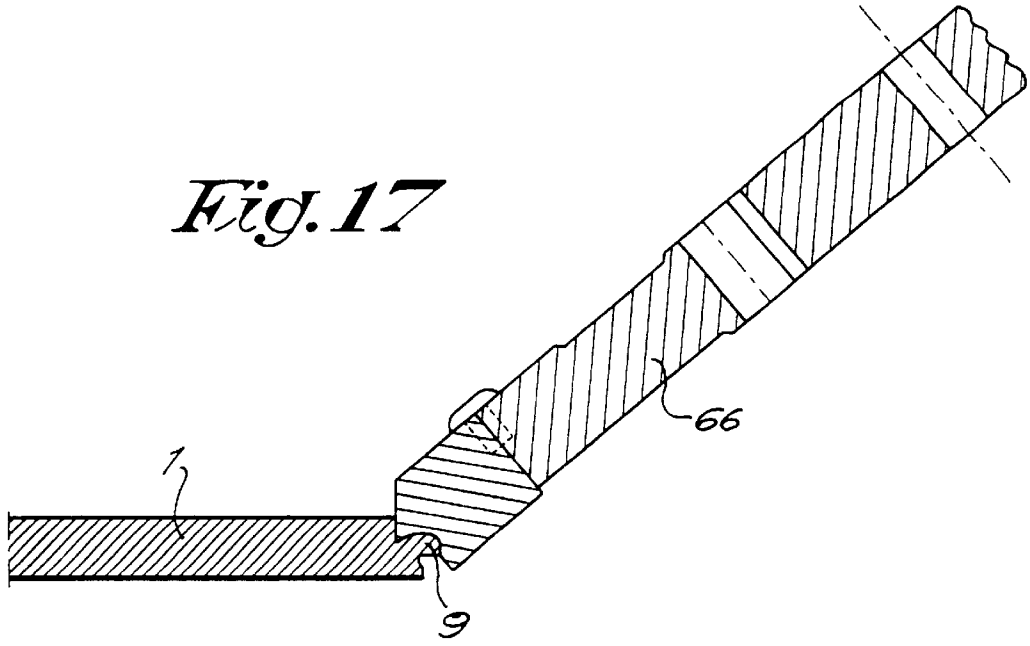


Fig. 16

Fig. 17



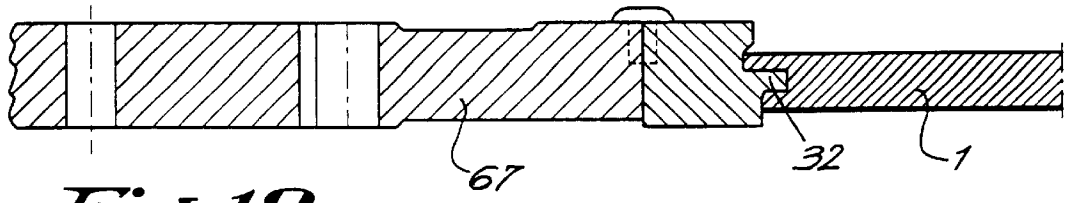


Fig. 18

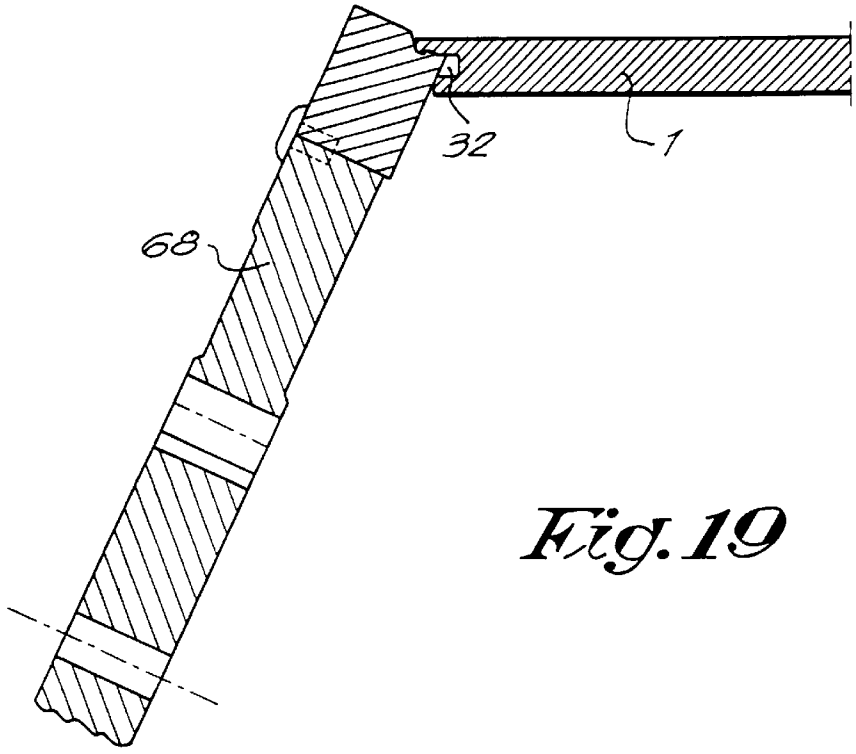


Fig. 19

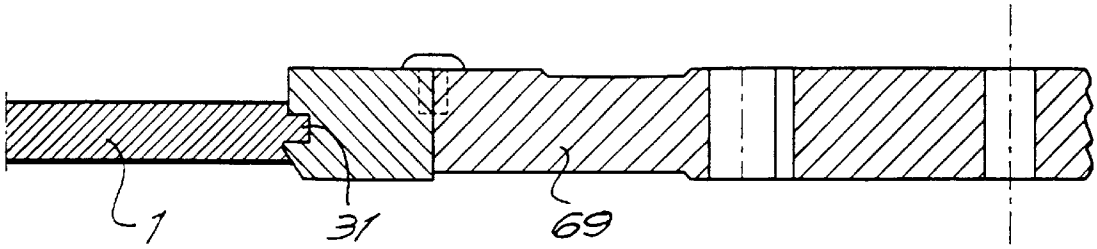


Fig. 20

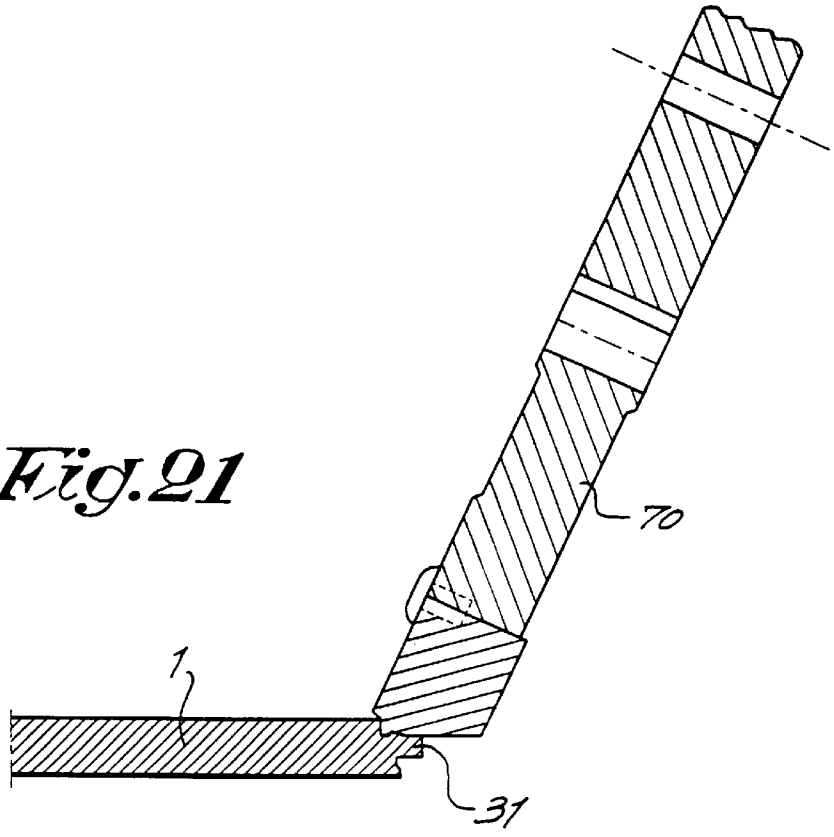
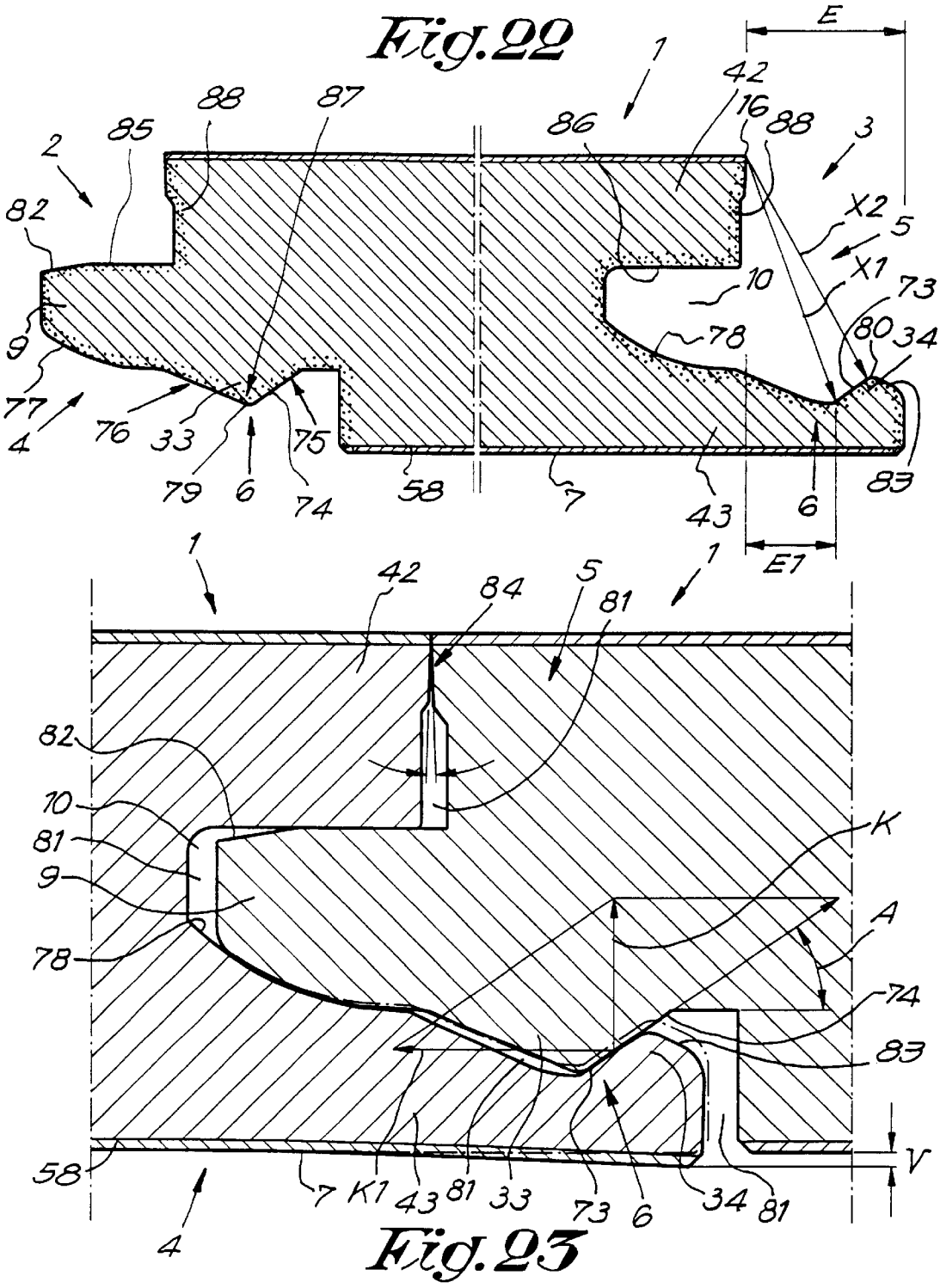


Fig. 21


E
1
42
16
88
3
86
88
87
85
2
82
X2
5
X1
73
10
9
78
80
34
77
4
76
33
75
79
6
74
58
7
43
6
83
E1
1
42
84
5
81
1
82
10
81
9
78
K
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83
58
4
7
K1
43
81
33
73
6
34
81
V

Fig. 22

Fig. 23

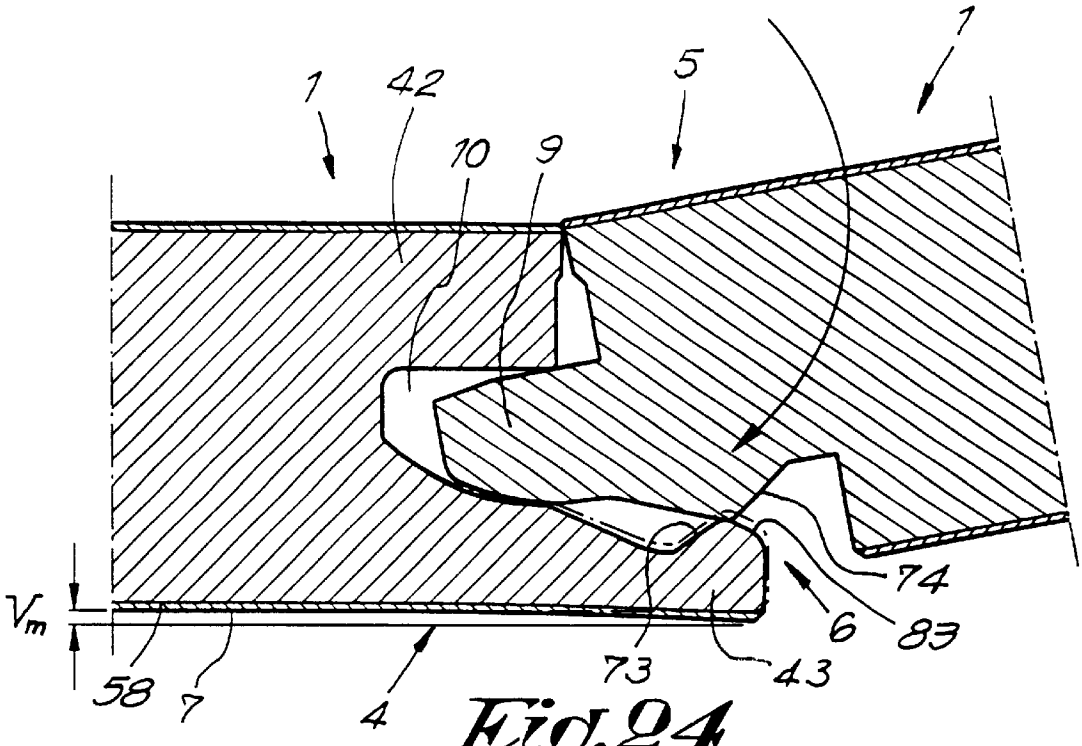
1
42
10
9
5
1
74
6
83
V_m
58
7
4
73
43

Fig.24

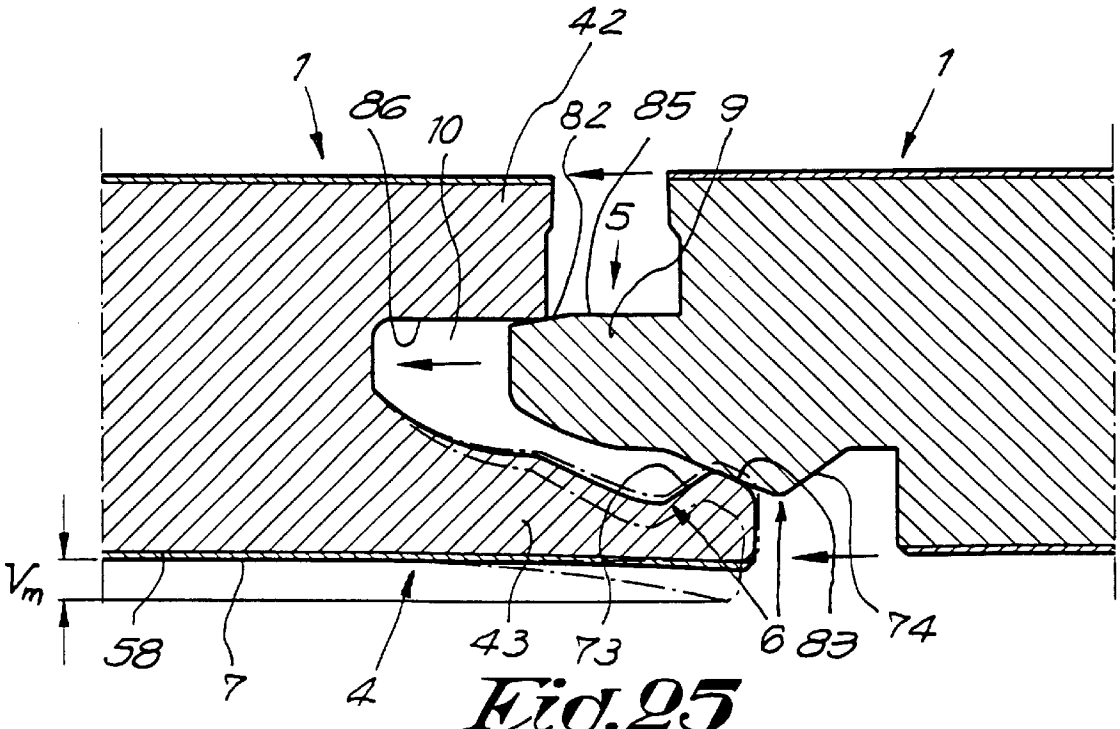
42
1
86
10
82
85
9
1
5
V_m
58
7
4
43
73
6
83
74

Fig.25

FLOOR PANEL WITH EDGE CONNECTORS

RELATED APPLICATION DATA

This application is a continuation of application Ser. No. 08/872,044 filed Jun. 10, 1997 now U.S. Pat. No. 6,006,486.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a floor covering, made of hard floor panels.

2. Related Technology

In the first instance, the invention is intended for so-called laminated floors, but generally it can also be applied for other kinds of floor covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring.

It is known that such floor panels can be applied in various ways.

According to a first possibility, the floor panels are attached at the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels.

According to a second possibility, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena.

A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks.

In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation.

Examples of embodiments which apply such metal connection elements are described, among others, in the documents WO 94/26999 and WO 93/13280.

Furthermore, couplings are known which allow coupling parts to snap fit into each other, e.g., from the documents WO 94/1628, WO 96/27719 and WO 96/27721. The snapping-together effect obtained with these forms of embodiment, however, does not guarantee a 100-percent optimum counteraction against the development of gaps between the floor panels, more particularly, because in fact well-defined plays have to be provided in order to be sure that the snapping-together is possible.

From GB 424.057, a coupling for parquetry parts is known which, in consideration of the nature of the coupling, only is appropriate for massive wooden parquetry.

Furthermore, there are also couplings for panels known from the documents GB 2.117.813, GB 2,256.023 and DE 3.544.845. These couplings, however, are not appropriate for connecting floor panels.

BRIEF SUMMARY OF THE INVENTION

The invention aims at an improved floor covering of the aforementioned type, the floor panels of which can be coupled to each other in an optimum manner and/or the floor panels of which can be manufactured in a smooth manner, and whereby preferably one or more of the aforementioned disadvantages are excluded.

The invention also aims at a floor covering which has the advantage that no mistakes during installing, such as gaps and such, can be created.

Furthermore, the invention also aims at a floor covering whereby the subsequent development of gaps is excluded or at least counteracted in an optimum manner, whereby also the possibility of the penetration of dirt and humidity is minimalized.

To this aim, the invention relates to a floor covering, consisting of hard floor panels which, at least at the edges of the two opposite sides, are provided with coupling parts, cooperating which each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels into a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels. Hereby, these coupling parts are optimalized in such a manner that they allow that any form of play is counteracted and preferably is excluded.

By integrated mechanical locking elements is understood that these form a fixed part of the floor panels, either by being connected in a fixed manner to the floor panels, or by being formed in one piece therewith.

In a first important preferred form of embodiment, the coupling parts are provided with locking elements which, in the engaged position of two or more of such floor panels, exert a tension force upon each other which force the floor panels towards each other. As a result of this that not only the formation of gaps counteracted during installation, but also in a later stage the development of gaps, from any causes whatsoever, is counteracted.

According to another characteristic of the intention, the coupling parts, hereby are formed in one piece with the core of the floor panels.

According to a second important preferred embodiment, the aforementioned optimalization is achieved in that the floor covering panel possesses the following combination of characteristics: the coupling parts and locking elements are formed in one piece with the core of the floor panels; the coupling parts have such a shape that two subsequent floor panels can be engaged into each other exclusively by snapping together and/or turning, whereby each subsequent floor panel can be inserted laterally into the previous; the coupling parts are interlocked free from pay in all directions in a plane extending perpendicular to the aforementioned edges; the possible difference between the upper and lower lip of the lips which border the aforementioned grooves, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than one time the total of the thickness of the panel; the total thickness of each related floor panel is larger than or equal to 5 mm; and that the basic material of the floor panels, of which the aforementioned core and locking elements are formed, consists of a ground product which, by means of a binding agent or by means of melting together, is made into a unitary composite, and/or of a product on the basis of synthetic material and/or of a chip board with fine chips.

Due to the fact that the coupling parts provide for an interlocking free from play, as well as due to the fact that these coupling parts are manufactured in one piece, from the basic material of the floor panels, a perfect connection between adjacent floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of characteristics can be combined or not with the aforementioned characteristic that the locking elements exert a tension force upon each other when panels are joined together.

According to a third important preferred embodiment, the characteristics of which may or may not be combined with the characteristics of the embodiments described above, the floor covering is characterized in that the lower lip which limits or defines the lower side of the groove, extends beyond the upper lip in the plane of the panel; the locking elements are formed at least of a contact portion which inwardly slopes downward; and that this portion, at least partially, is located in the portion of the lower lip which extends beyond the upper lip. The advantages of these features will appear from the further description.

According to a preferred form of embodiment, the floor panels are configured as elongated panels and the coupling parts described above are applied along the longitudinal sides of these panels.

According to a particular form of embodiment, coupling parts are provided at the other two sides, too, either of another construction than described above or not.

In the most preferred form of embodiment, for the basic material use shall be made of the aforementioned product, which, as said, is ground and, by means of a binding agent, made into a unitary composite material. More particularly, for the core use shall be made of finely-ground wood which preferably is glued, more particularly, moisture resistant glued. Still more particularly, for the core use shall be made of so-called HDF board (High Density Fibreboard) or MDF board (Medium Density Fibreboard) which is highly compressed ground wood particles and binder material. Hereinafter, the wood component of the core material shall be referred to as "wood product".

The fact that the invention is applied to floor panels the basic material of which consists of the material described above, offers the advantage that with he processing of this material, very smooth surfaces are obtained whereby very precise couplings can be realized, which, in first instance, is important in the case of a snap-together connection and/or turning connection free from play. Also, very special forms of coupling parts can be manufactured in a very simple manner because the aforementioned kinds of material can be processed particularly easy.

The surfaces obtained with HDF and MDF also have the advantage that the floor panels mutually can be shifted readily alongside each other in interlocked condition, even when engaged with a tensioning force.

The applicants also discovered that the aforementioned materials, in particular HDF and MDF, show ideal features in order to realize a connection, such as mentioned above, as these material show the right features in respect to elastic deformation in order to, on the one hand, realize a snap-together effect, and, on the other hand, receive expansion and shrinkage forces in an elastic manner, whereby it is avoided that the floor panels come unlocked or are damaged in an irreparable manner.

In the case that for the core use is made of a material based on synthetic material, to this end solid synthetic material can be used as well as a mixture of synthetic materials, eventually composed of recycled materials.

The floor covering preferably is formed by joining the floor panels into each other free of glue. Hereby, the connections are of such nature that the floor panels can be disassembled without being damaged, such that, for example, when moving from one residence or location to another, they can be taken along in order to be placed down again. It is, however, clear that a glueing between tongue and groove is not excluded.

The invention, of course, also relates to floor panels which allow the realization of the aforementioned floor covering.

The invention also relates to a method for the manufacturing of the aforementioned floor panels with which the advantage that the tongues and/or grooves, including the corresponding locking means, can be provided at the floor panels at high production speeds without problems. More particularly, it aims at a method which allows that the rather complicated forms of the tongue and the groove of the aforementioned floor panels can be formed completely by means of milling cutters, the diameter of which can be chosen independent of the form to be realized, such that the use of small milling cutters, for example finger cutters, with diameters smaller than the depth of the tongue or groove can be excluded.

In accordance with this method the tongue and/or groove is formed by means of a milling process using at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in respect to the related floor panel. During each of the aforementioned milling cycles, preferably substantially the final form of one flank, either of the tongue or of the groove, is formed.

For the aforementioned two milling cycles, thus, milling cutters are used which extend outside the groove, respectively the tongue. More particularly the diameters of these milling cutters shall at least be 5 times and even better 20 times larger than the thickness of the floor panels.

The use of milling cutters having the aforementioned diameters has as an advantage that the normal production speeds can be maintained which are also applied during milling of a classical straight tongue and groove. There is also the advantage obtained that the installation of such milling cutters induce only minor or no additional costs because such milling cutters can be placed directly upon a motor shaft and/or the conventional machines can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

With the intention of better showing the characteristics according to the invention, in the following, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

FIG. **1** represents a floor panel of a floor covering according to the invention;

FIG. **2**, on a larger scale, represents a cross-section according to line II—II in FIG. **1**;

FIGS. **3** and **4** represent how two floor panels with coupling parts according to FIG. **2** match into each other;

FIG. **5**, on a larger scale, represents a cross-section according to line V—V in FIG. **1**;

FIGS. **6** and **7** represent how two floor panels with coupling parts according to FIG. **5** match into each other;

FIGS. **8** to **11** represent a number of variants of coupling parts of floor panels according to the invention;

FIG. **12** schematically represents how the floor parts can be provided with coupling parts;

FIG. **13** represents a cross-section according to line XIII—XIII in FIG. **12**;

FIGS. **14** to **21**, on a larger scale and in cross-section, represent the penetration of the milling cutters which are indicated in FIG. **12** with arrows F**14** to F**21**;

FIG. **22** represents a floor panel according to the invention;

FIG. **23**, on a larger scale, represents the coupling of two floor panels of FIG. **22**;

FIGS. **24** and **25** represent two manners of coupling floor panels according to FIG. **22** to each other.

DETAILED DESCRIPTION

The invention relates to a floor covering which is composed of hard floor panels **1**, for example, such as a laminated panel as shown in FIG. **1**.

These floor panels **1** can be of various shape, for example, rectangular or square, or of any other shape.

In the most preferred form of embodiment, they shall be manufactured in an elongated form, such as shown in FIG. **1**, for example, with a length of 1 to 2 meters. The thickness, however, can also vary, but is preferably 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel **1** is, at least at the edges of two opposite sides **2**–**3**, provided with coupling parts **4**–**5** which permit two adjacent identical floor panels **1** to be coupled to each other.

According to the invention, the coupling parts **4**–**5**, as represented in the FIGS. **2** to **4**, are provided with integrated mechanical locking parts or locking elements **6** which prevent the drifting or sliding apart of two coupled floor panels **1** in a direction D perpendicular to the respective sides **2**–**3** and parallel to the underside **7** of the coupled floor panels **1**; the coupling parts **4**–**5** and the locking elements **6** are formed in one piece with the core **8** of the floor panels **1**; the coupling parts **4**–**5** have such a shape that two subsequent floor panels **1** can be engaged into each other solely by snapping-together and/or turning after the coupling parts are partially engaged, whereby each subsequent floor panel **1** can be laterally inserted into the previous; and the coupling parts **4**–**5** preferably are interlocked free from play in all directions in a plane which is located perpendicular to the aforementioned edges.

In the case of floor panels **1** with an elongated shape, as represented in FIG. **1**, the respective coupling parts **4**–**5** are located at the longitudinal sides **2**–**3**.

The coupling parts **4**–**5** can be realized in various forms, although the basic forms thereof will always be formed by a tongue **9** and a groove **10**.

In the form of embodiment of FIGS. **2** to **4**, the related floor panel **1** is provided with coupling parts **4**–**5** and locking means or locking elements **6** which allow two floor panels **1** to be mutually engaged by means of a turning movement, without the occurrence of any snap-together effect.

In the represented example, the locking elements **6** consist of a first locking element **11**, formed by a protrusion with a bent round shape at the lower side **12** of the tongue **9**, and a second locking element **13** (shown in FIG. **2**), formed by a recess with a bent hollow or downwardly concave shape in the lower wall **14** of the groove **10**.

The locking elements **11**–**13** ensure that two floor panels **1** which are coupled to each other can not move laterally in the horizontal plane with respect to each other.

In order to enable two floor panels **1** to be inserted into each other by means of a turning movement, the curvatures preferably are circular. The bottom side **12** of locking means or locking elements **6** has a curvature with a radius R**1**, the center of which coincides with the respective upper edge **15** of the floor panel **1**, whereas the lower wall **14** of the locking part **5** has a curvature with a radius R**2** which is equal to the radius R**1**, but its center coincides with the respective upper edge **16**. Radii R**1** and R**2** may also be applied which are larger or smaller than the distance to the upper edge **15**, **16** respectively, and/or which differ from each other in size.

The upper side **17** of the tongue **9** and the upper wall or side **18** of the groove **10** are preferably flat and preferably are located in the horizontal plane.

The inner side **20** of the groove **10** and the **4** front side **19** of the tongue **9** of the two interlocked floor panels **1** preferably do not fit closely against each other, such that an intermediate space **21** is created between them into which possible dust remainders or such can be pushed away by means of the tongue **9**.

The tongue **9** and the groove **10** preferably have shapes which are complementary to each other, such that the tongue **9** in the engaged condition of two identical floor panels **1** precisely sits against the upper wall **18** and the lower wall **14** of the groove **10**, whereby a pressure P, exerted against the upper lip **22**, is received or reacted not only by this lip **22**, but by the complete structure, because this pressure can be transmitted through the tongue **9** and the lower lip **23** to cause the panels to be urged towards each other.

It is, however, clear that a number of minor deviations to these complementary forms can occur which, anyhow, have no or almost no effect upon the receipt and transmission of pressure forces. For example, a chamfer **24** and lip **22** on a recess **25** can be provided, as represented in FIGS. **2** to **4**, as a result of which the subsequent floor panels **1** can easily be pushed and guided into each other, such that no possible ridges in the subflooring or such render good insertion difficult.

As represented in the FIGS. **5** to **7**, the floor panels **1** according to the invention can also, along the sides **26**–**27** which are at a right angle to the sides **2**–**3**, be provided with coupling parts **28**–**29** which have locking elements **30**, too. The coupling parts **28**–**29** are preferably also realized in the shape of a tongue **31** and a groove **32**. Hereby, the locking elements **30** do not have to be of the same nature as the locking elements **6**.

Preferably, at the sides **26**–**27** locking elements are provided which allow for an engagement and interlocking by means of a lateral translation movement in direction T only, as represented in FIGS. **6** and **7**. To this aim, the locking elements **30** consist of a snap-together connection with locking elements **33** and **34** which grip behind each other.

As represented in FIGS. **5** to **7**, the locking element **33** preferably consists of a protrusion of the lower side **35** of the tongue **31** which can be located in a recess **36** in a lower lip **43** extending distally from the lower wall **37** of the groove **32**. The locking element **34** is formed by the upward directed part or protrusion which defines the distally outer end of recess **36**.

In this case, the locking elements **33**–**34** have contact surfaces **38**–**39** which are parallel to each other and preferably extend in an inclined manner, according to a direction which simplifies the snapping-together of the panels. The common plane of tangency L which is determined by the common tangent at the meeting point or area of surfaces **38**–**39**, hereby forms an angle A sloping inwardly and downwardly from an outer region to an inner region relative to the underside **7**, which angle is smaller than 90°.

The locking elements **33–34** preferably are provided with inclined portions **40** and **41** which, when two floor panels **1** are engaged, cooperate with each other in such a manner that the locking elements **33–34** can easily be pushed over each other until they grip behind each other by means of a snap-together effect (FIGS. **6** and **7**).

The thickness W1 of the tongue **31** preferably is equal to the width W2 of the groove **32**, such that compression pressure P applied to the upper lip **42** is reacted by the tongue **31** which, in its turn, then is reacted by the lower lip **43**.

Analogous to the chamfer **24** and recess **25**, a recess **44** and a chamfer **45** are provided also at the edges **28–29**.

It is noted that such a snap-together coupling can also be applied at the edges **2–3**. Hereby, this can be a snap-together coupling analogous to these of FIGS. **5** to **7**, but this can also be a snap-together coupling using other forms of coupling configurations, for example, such as represented in FIGS. **8** and **9**. Contrary to the locking elements **33–34** which consist of rather local protrusions, in the forms of embodiment of FIGS. **8** and **9** use is made of locking elements **46–47** which, in comparison to the total width B of the coupling, extend over a rather large distance.

In this case, the locking elements **46–47** are also provided at the lower side **12** of the tongue **9** and the lower wall **14** of the groove **10**.

According to FIG. **8**, the locking elements **46–47** have contact surfaces **48–49** which are at an angle with the plane of the floor panel **1**. In this manner, a coupling is obtained which is interlocked in a particularly fixed manner.

As represented in FIG. **9**, the locking elements **46–47** possibly can be configured in such a manner that substantially only a linear contact is obtained, for example, because the contact surfaces directed towards each other are formed with different curvatures.

The surfaces, directed towards each other, of the locking elements **46–47** hereby consist of curved surfaces. The common plane of tangency L forms an angle A which is smaller than 90°, and more preferably is smaller than 70°.

In this manner, the locking element **46** preferably has two portions with a different curvature, on one hand, a portion **50** with a strong curvature and, on the other hand, a portion **51** with a weak curvature. The portion **50** with the strong curvature provides for the formation of a firm coupling. The portion **51** with the weak curvature facilitates the coupling parts **4–5** to be brought into each other easily. The intermediate space S forms a chamber which offers space for dust and the like which, when engaging two floor panes **1**, inevitably infiltrates there.

In the case of a snap-together connection, for example, a connection such as represented in FIGS. **7** to **9**, preferably the tongue **9–31** has a shape that thickens from below, which then can cooperate with a widened portion in the groove **10**.

In FIG. **10**, a variant is represented whereby at least at the level of the upper edges **15–16**, a sealing material **52** is provided, as a result of which a watertight sealing can be assured. This sealing material **52** may consist of a strip or covering which is provided previously at the floor panel **1**, either at one or both upperside edges **15–16**.

In FIG. **11**, a further variant is represented, whereby the locking element **6** is formed by an upward directed portion **53** at the tongue **9**, which as a result of a turning movement of the panel, is brought behind a downward-directed portion **54** on the upper wall **18**. More particularly, this is obtained by forming the upper side **17** and the upper wall **18** with a curvature R3, the center of which is situated at the upperside edges **15–16**, and forming the lower side **12** and the lower wall **14** with a radius R4, the center of which is also situated at the upperside edges **15** and **16**, respectively. These radii R3–R4 can be chosen otherwise, too.

In general, according to the invention, the difference between, on one hand, the radius R1, R3 respectively, and, on the other hand, the radius R2, R4 respectively, preferably should not be larger than 2 mm.

It is also preferred that the center of these radii be situated inside the circle C1, C2 (see FIG. **2**) respectively, which extends with a radius R5 of 3 mm centered at upperside edge **15**, **16** respectively.

Finally is noted that, according to the invention, the lower lip **23–43**, as represented in FIGS. **2** to **7**, can be formed distally longer than the upper lip **22–42**. This has an advantage that the coupling parts **4–5–28–29** can be shaped in an easier manner by means of a milling cutter or the like. Furthermore, this simplifies the engagement of two floor panels **1**, because each subsequent floor panel **1** during installation can be placed upon the protruding lower lip **23–43**, as a result of which the tongue **9–31** and the groove **10–32** automatically are positioned in front of each other.

The embodiments wherein the lower lip **23** is equal to or distally shorter than the upper lip **22**, in their turn, offer the advantage that no protruding lip **23** remains at the extreme edge of the floor which might cause problems in finishing the floor installation.

In order to allow for a smooth assembly, to guarantee the necessary stability and firmness and in order to limit the quantity of material to be cut away, the difference E between the distally outer edge of the upper lip **22–42** and the distally outer edge of the lower lip **23–43**, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove **10**, should preferably be kept smaller than one time the total thickness F of the floor panel **1**. For stability's sake, normally this total thickness F shall never be less than 5 mm.

The small dimension of the difference E offers the advantage that the lower lip need not be strengthened by a reinforcement strip or the like.

According to a particular form of embodiment, the central line M1 through the tongue **9** and the groove **10** is situated lower than the center line M2 of the floor panel **1**, such, that the upper lip **22–42** is thicker than the lower lip **23–43**. In first instance, this is essential in this kind of connection, because then it is the lower lip **23–43** which bends, whereby the upper side of the floor panel **1** is kept free of possible deformations.

As explained in the introduction, for the core **8** a material is chosen from the following series:

a. a ground product which, by means of a binding agent or by means of melting together is made into a unitary composite material;
   a product based on synthetic material;
   chip board with fine chips.

The invention shows its usefulness, in first instance, preferably with laminated flooring, due to the reasons explained in the introduction.

As represented in the examples of the FIGS. **2** to **11**, such laminated flooring preferably consists of a core **8** made of MDF medium density fiberboard board, HDF high density fiberboard board or similar, whereby at least at the upper side of this core **8** one or more layers of material are provided.

More particularly, it is preferred that the laminated flooring is provided with a decorative layer **55** and a protective

top layer **56**. The decorative layer **55** is a layer, impregnated with resin, for example, made of paper, which can be imprinted with a variety of patterns, such as a wood pattern, a pattern in the form of stone, cork, or similar or even with a fancy pattern. The protective top layer **56** preferably also consists of a layer saturated with resin, for example, melamine resin, which in the final product is transparent.

It is clear that still other layers can be applied, such as an intermediate layer **57** upon which the decorative layer **55** is provided.

Preferably, also a backing layer **58** shall be applied at the underside **7**, forming a counterbalancing element for the top layers and, thus, guaranteeing the stability of the form of the floor panel **1**. This backing layer **58** may consist of a material, for example paper, impregnated with a resin, for example, a melamine resin.

As represented schematically in FIG. **12**, the tongue **9** and the groove **10**, and preferably also the tongue **31** and the groove **32** are formed by means of a milling process. In the case that a profile has to be applied on all four sides, the floor panels **1** preferably shall be displaced by means of two sequential perpendicular movements V**1** and V**2**, whereby during the first movement profiles at two opposite edges are provided, in this case the longitudinal edges, by means of milling devices **59–60**, whereas during the second movement profiles are provided at the other edges, in this case the small edges, by means of milling devices **61–62**. During these processing, the floor panels **1** preferably are put with their decorative layer directed downward.

According to an important characteristic of the invention, each respective tongue **9–31** and groove **10–32** are formed by means of a milling process with at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in reference to the related floor panel **1**.

This is illustrated in FIGS. **13**, **14** and **15**, wherein it is represented how a groove **10** is realized by means of two milling cycles by means of two milling cutters **63** and **64**. FIGS. **16** and **17** represent how the tongue **9** is shaped by means of milling cutters **65** and **66**.

The FIGS. **18–19** and **20–21** represent similar views showing how the groove **32** and the tongue **31** are shaped by means of milling cutters **67–68** and **69–70**, positioned at an angle.

During each of the aforementioned milling passes, substantially the final shape of one flank is fully realized. For example, the milling cutter **63** of FIG. **14** determines the final shape of the lower flank **71** of the groove **10**, whereas the milling cutter **64** determines the final shape of the upper flank **72**.

As mentioned in the introduction, preferably milling cutters **63** to **72** shall be used, having diameters G which are at least 5 times, and even better at least 20 times larger than the thickness F of the floor panels **1**.

Apart of the mentioned milling cutters, preferably still other milling cutters are applied, for example, in order to remove a part of the material to be removed during a first premachining cycle.

In the FIGS. **22** to **25**, a particularly preferred form of embodiment of a floor panel **1** according to the invention is represented. Hereby, the parts which correspond with the previous embodiments are indicated with corresponding references.

An important characteristic herein consists in that the coupling parts **4–5** are provided with locking elements **6** which, in engaged condition with the panels in a common plane, exert a tension force upon each other, as a result of which the engaged floor panels **1** are forced towards each other in compression. As represented, this is realized preferably by providing the coupling parts with an elastically yieldable or bendable portion, in this case the lower lip **43**, which, in engaged condition, is at least partially bent and in this way creates a tension force which results in the engaged floor panels **1** being forced towards each other. The resultant bending V, as well as the tension force K, are indicated in the enlargement view of FIG. **23**.

In order to obtain the tension force K pressing together the engaged floor panels **1**, the bendable portion, in this case the lip **43**, preferably is provided, as represented, with an inwardly and downwardly inclined contact surface **73** which preferably can cooperate with a corresponding contact surface **74** on tongue **9**. These contact surfaces **73–74** are similar to the aforementioned contact surfaces **39–38** and also similar to the inclined portions of the lower lip of FIGS. **2** to **4**.

In the FIGS. **2** and **5**, the portions form complementary matching shapes; it is, however, clear that, by a modification, also a tension effect similar to that shown in FIG. **23** can be realized.

Due to, on one hand, the contact along the angle A, and, on the other hand, the fact that a tension force K is created, a compression force component K**1** is produced, as a result of which the floor panels **1** are drawn against each other in compression.

Preferably, the angle A of the mutual plane of tangency of contact surfaces **73–74** relative to the horizontal plane is situated between 30 and 70 degrees. In the case that use is made of the embodiment whereby a tension force K is realized, an angle A of 30 to 70 degrees is ideal in order, on one hand, to effect an optimum pressing-together of the floor panels **1** and, on the other hand, to ensure that the floor panels **1** can easily be engaged and respectively disassembled.

Although the pressing or compression force component K**1** preferably is delivered by the aforementioned lip **43**, the invention does not exclude other forms of locking elements or structures whereby this force is delivered by other bendable portions.

It is noted that the bending V is relatively small, for example, several hundredths up to several tenths of a millimeter, and does not have an influence upon the placement of the floor covering. Furthermore it should be noted that such floor covering generally is placed upon an underlayer (not shown) which is elastically compressible, as a result of which the bending V of the lip **43** only produces local bending of the underlayer.

Due to the fact that the lip **43** is bent apart and that it remains somewhat bent apart in engaged position, the additional advantage is obtained that, when exerting a pressure upon the floor covering, for example, when placing an object thereupon, the pressing-together compressive force is enhanced and, thus, the development of gaps is counteracted even more.

It is noted that the inventors have found that, contrary to all expectations, an ideal tension force can be realized by manufacturing the coupling parts **4–5**, including the locking elements **33–34**, and preferably the complete core **8**, of HDF board or MDF board, although these material normally only allow a minor elastic deformation.

HDF and MDF also offer the advantage that smooth surfaces are obtained, as a result of which the locking elements can be moved easily over each other.

According to a variant of the invention, the tension force can also be supplied by means of an elastic compression of

the material of the coupling parts themselves, to which end these coupling parts, and preferably the complete core **8**, would be manufactured using an elastically compressible material.

A further particular characteristic of the embodiment of FIGS. **22** to **25** consists in that the floor panels **1** can be selectively engaged by means of a turning movement, as represented in FIG. **24**, as well as by means of laterally shifting them towards each other in substantially a common plane, as represented in FIG. **25**, preferably in such a manner that, during the engagement by means of the turning movement with the coupling parts partially engaged, a maximum bending Vm results in the coupling parts, more particularly in the lip **43**, which bending Vm is less pronounced, if not nonexistent, as in the FIGS. **2** to **4**, in comparison to the bending Vm which results when the floor panels **1** are engaged by means of shifting them towards each other, as in FIG. **15**.

The advantage of this consists in that the floor panels **1** can be engaged easily by means of a turning movement, without necessitating use of a tool therefore, whereas it still remains possible to engage the floor panels also by means of shifting them laterally. This latter is useful, in first instance, when the last panel has to be placed partially under a door frame or similar situation. In this case, the floor panel **1** can be pushed under the door frame with the side which does not have to be engaged and subsequently, possibly by means of tools, can be snapped into the adjacent floor panel by lateral sliding together.

It is noted that the shapes of the coupling parts **4–5** shown in FIGS. **22** to **25** can also be used for the coupling parts **28–29** of the short sides of the panels.

According to the invention, in the case that the four sides **2–3–26–27** are provided with coupling pars **4–5–28–29**, these coupling parts can be formed in such a manner that in one direction a firmer engagement than in the other direction is effected. In the case of elongated floor panels **1**, for example, such as represented in FIG. **1**, the locking at the small sides **26–27** preferably shall be more pronounced than at the longitudinal sides **2–3**. The length of the parts at the small sides, namely, is smaller and, in principle, less firm. This is compensated for by providing a more pronounced locking.

This difference in engagement can be obtained by shaping the contact surfaces **73–74** with different angles.

Preferably, the aforementioned protrusion, more particularly the locking element **33**, is bounded by at least two portions **75–76** (shown in FIG. **22**), respectively a portion **75** with a strong (steep) inclination which provides for the locking, and a portion **76** with a weaker (less inclined) inclination which renders the engagement or guidance of the coupling parts easier. In the embodiment of FIGS. **22** to **25**, these portions **75–76** are formed by straight planes, but, as already described with reference to FIG. **9**, use can also be made of curved portions **50–51**. In FIG. **5**, these are the contact surface **38** and the inclined portion **40**.

In the preferred form of the invention, the floor panels **1** comprise coupling parts **4–5** and/or **28–29** exhibiting one of the following or the combination of two or more of the following features:

- a curvature **77** (shown in FIG. **22**) at the lower side of the tongue **9** and/or a curvature **78** at the lower lip **43** which form a guidance when turning two floor panels **1** into each other, with the advantage that the floor panels **1** can be engaged into each other easily during installation;
- roundings **79–80** at the edges of the locking elements **33–34**, with the advantages that the locking elements can easily shift over each other during their engagement, or during disassembly of the floor panels **1** and that the locking elements will not be damaged, for example, crumble away at their edges, even if the floor panels are engaged and disassembled;
- dust chambers **81**, or spaces **21** as in FIG. **4**, between all sides, directed laterally towards each other, of the engaged floor panels **1**, with the advantage that inclusions which get between the floor panels **1** during the engagement do not exert an adverse influence upon good engagement;
- a shaping of the tongue **9** which is such, for example, by the presence of a chamfer **82**, that the upper side of the tongue **9** becomes situated from the first joining together or substantial contact of the panels, under the lower side of the upper lip **42** when the floor panels **1** are pushed towards each other in substantially the same plane, as indicated in FIG. **25**, with the advantage that the front extremity or end of the tongue **9** does not press against the front side of the upper lip **42** or the front edge of the bottom lip **43** when the floor panels are pushed towards each other in the same plane;
- a ramp surface **83**, hereinbefore also called inclined portion **41**, formed at the distally outer end of the lower lip **43**, with the advantage that the locking elements **33–34** shift smoothly over each other and that the lower lip **43** is bent uniformly;
- in the engagement direction only one important contact point which is formed by a section **84** at the location of the upperside edges of the floor panels **1**, with the advantage that the aforementioned tension force is optimally transferred to the upper side of the floor panels **1** and that the development of openings between the floor panels **1** is counteracted;
- contact surfaces **85–86**, more particularly abutment surfaces, formed by the upper side of the tongue **9** and the upper side of the groove **10** which, over the largest portion of their length, are flat and run parallel to the plane which is defined by the floor panels **1**, as well as contact surfaces cooperating with each other, formed by curvatures **77–78**, with the advantage that no mutual displacement in height between two engaged floor panels **1** is possible, even if the insertion depth of the tongue **9** into the groove **10** should vary due to various causes; in other words, no height differences may occur between the adjacent floor panels.

In the embodiment of FIGS. **22** to **25**, all these characteristics are combined; it is, however, clear that, as becomes evident from FIGS. **2** to **11**, these features can also be provided separately or in a limited combination with one another.

As becomes evident from FIGS. **5** to **7** and **22** to **25**, an important characteristic of the preferred embodiment of the invention consists in that the cooperative locking element **6**, in other words, the portion providing for the snap-together and engagement effect, are situated in that portion of the lower lip **23–43** which extends beyond the distal edge of the upper lip **22–42**, more particularly, the lowermost point **87** of the locking part **33** is situated under the top layer of the floor panel **1**. For clarity's sake, this top layer is indicated in the FIGS. **22–25** only as a single layer.

It should be noted that the combination of features, the lower lip **23–43** extending further than the upper lip **22–42**; the locking elements **6** being formed at least by means of a contact surface portion which inwardly slopes downward, and wherein this portion, at least partially, is located in the

portion of the lower lip **23–43** which extends distally beyond the upper lip **22–42**, is particularly advantageous, among others, in comparison with the couplings for floor panels described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The sloping contact surface portion offers the advantage that the floor panels **1** can be disassembled again. The fact that this sloping portion is situated in the extended portion of the lower lip **23–43** adds the advantage that no deformations can occur during coupling which manifest themselves up to the top layer.

According to a preferred characteristic of the invention, the aforementioned portion, i.e. the contact surface **39** or **73**, preferably extends in such a manner that the distance between the upper edge **16** of the panel to the contact surface **39**, **73** diminishes between the proximal and distal ends of the sloping contact surface **39**, **73**, in other words, such that, as represented in FIG. **22**, the distance X2 is smaller than the distance X1. This is also the case in FIG. **7**.

Still preferably, this portion only starts at a clear distance E1 from the outer edge of upper lip **42**.

It is obvious that the coupling parts **22** to **25** can also be shaped by means of said milling process.

According to a particular characteristic of the invention, the floor panels **1** are treated at their sides **2–3** and/or **26–27** with a surface densifying agent, more particularly a surface hardening agent, which preferably is chosen from the following series of products: impregnation agents, pore-sealing agents, lacquers, resins, oils, paraffins and the like.

In FIG. **22**, such impregnation **88** is represented schematically. This treatment can be performed over the complete surface of the sides **2–3** and/or **26–27** or only over specific portions hereof, for example exclusively on the surfaces of the tongue **9** and the groove **10**.

The treatment with a surface densifying agent offers, in combination with the snap-together effect, the advantage that in various aspects better coupling characteristics are obtained. As a result of this, the coupling parts **4–5** and/or **28–29** better keep their shape and strength, even if the floor panels **1** are engaged and disassembled repeatedly. In particular, if the core **8** is made of HDF, MDF or similar materials, by means of this treatment a better quality of surface condition is obtained, such that no abrasion of material occurs during engaging, or during disassembling.

This treatment also offers the advantage that, at least in the case of a surface hardening, the aforementioned elastic tensioning effect is enhanced.

The present invention is in no way limited to the forms of embodiment described by way of example and represented in the figures, however, such floor covering and the pertaining floor panels **1** can be embodied in various forms and dimensions without departing from the scope of the invention.

For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other.

Furthermore, all embodiments of coupling elements described before can be applied at the longer side as well as at the shorter side of a panel.

What is claimed is:

1. A floor covering comprising a hard floor panel having a substantially planar underside and at least two opposed side edges, said side edges including complementary coupling parts configured to cooperate with identical cooperative complementary coupling parts of another one of said panel, said coupling parts comprising substantially a tongue and a groove extending along panel side edges generally parallel to the panel underside and including integrated mechanical locking elements, said tongue, groove and locking elements formed in one piece with the panel, said tongue, groove and locking elements arranged to prevent drifting apart of the floor panel when coupled by said coupling parts to another one of said floor panel in a direction perpendicular to the adjacent side edges of the coupled panels, and parallel to the underside of the panel; a coupling part of said panel, when engaged with a complementary coupling part of another one of said panel, configured and arranged to produce a biasing force between such coupled panels tending to urge the panels towards each other; at least one of said coupling parts including an elastically bendable portion having a relaxed unbent position, and which, when in a coupled condition, is at least partially bent out of its normal relaxed position and thereby provides said biasing force;

wherein the elastically bendable portion of said one of said coupling part comprises a lower lip defined at least in part by a lower side of the groove of said coupling parts, said lower lip cooperating with a mating portion of a tongue of a cooperating coupling part;

wherein said lip when bent extends in a downward direction relative to the panel underside when the panel is coupled by cooperative complementary coupling parts to another one of said panel;

wherein the panel comprises a core comprising a material selected from the group consisting of HDF and MDF board; said lower lip is substantially formed of said core; one of said locking elements comprises a recess in said lower lip, said recess having a lowermost bottom area; said groove having a deepest point within the panel; and wherein said elastically bendable portion of the lower lip comprises a portion of said lower lip located between the deepest point of said groove and the lowermost bottom area of said recess;

wherein the bendable portion of the lower lip includes a side wall of said recess that slopes downwardly in a direction extending from a distally outer area of said lip towards a proximally inner area of said lip.

2. A floor covering comprising a hard floor panel having a substantially planar underside and at least two opposed side edges, said side edges including complementary coupling parts configured to cooperate with identical cooperative complementary coupling parts of another one of said panel, said coupling parts comprising substantially a tongue and a groove extending along panel side edges generally parallel to the panel underside and including integrated mechanical locking elements, said tongue, groove and locking elements formed in one piece with the panel, said tongue, groove and locking elements arranged to prevent drifting apart of the floor panel when coupled by said coupling parts to another one of said floor panel in a direction perpendicular to the adjacent side edges of the coupled panels, and parallel to the underside of the panel; a coupling part of said panel, when engaged with a complementary coupling part of another one of said panel, configured and arranged to produce a biasing force between such coupled panels tending to urge the panels towards each other; at least one of said coupling parts including an elastically bendable portion having a relaxed unbent position, and which, when in a coupled condition, is at least partially bent out of its normal relaxed position and thereby provides said biasing force;

wherein said floor panel is rectangular and includes two pairs of opposed side edges; said coupling parts and locking elements are provided on all side edges of the

panel; and wherein said locking elements are provided on at least two side edges that are perpendicular to and meet each other whereby, when the panel is coupled with complementary coupling parts of identical ones of said panel at all opposed edges, the panels are locked together by said locking elements at all coupled side edges;

wherein said coupling parts are configured and arranged to enable coupling of complementary coupling parts of identical ones of said panel to each other by rotation of one panel relative to the other, said coupling parts configured such that upon rotation of one panel relative to the other panel the elastically bendable portion of one coupling part is bent; and wherein at coupled side edges of the coupled panels the coupling parts are configured such that one panel is movable relative to the other by shifting the one relative to the other in a direction parallel to the coupled side edges; said shifting of one panel relative to the other maintaining the bent condition of the elastically bendable portion of the lower lip while the panels are coupled.

3. A method of assembling a floor covering comprising cooperating rectangular hard floor panels each having a substantially planar underside and at least two opposed side edges including complementary coupling parts arranged to cooperate with identical complementary coupling parts of another one of said panels, said complementary coupling parts substantially comprising a tongue and a groove extending generally parallel to said underside, said coupling parts further including integrated mechanical locking elements which prevent the drifting apart of coupled ones of said panels away from each other in directions perpendicular to the respective coupled side edges and parallel to the undersides of the panels, said coupling parts defining at least in part a lower lip which defines at least a portion of a lower side of each groove of the coupling parts and an upper lip located above each groove area adjacent the upper surface of the panel; said lower lip extending distally beyond the upper lip; said locking elements including a portion of said lower lip which slopes downwardly in a direction extending from a distally outer location towards a proximally inner location, said portion located at least in part on a part of the lower lip extending beyond said upper lip, a lower side of said tongue that is inclined downwardly in a direction extending from proximal inner location of said tongue to a distally outer location thereof; said portion of said lower lip that slopes downwardly cooperating with said lower side of the tongue that is inclined, said lower lip including an elastically bendable portion that must be elastically bent downwardly to enable coupling of a complementary pair of tongue and groove coupling parts; comprising the steps of:

laying a first one of said panels on a support surface;

coupling a second one of said panels to said first one panel along first and second complementary side edges of the panels by fitting a tongue of one panel into a complementary groove of the other panel until said downwardly sloping portion of said lower lip engages said downwardly inclined lower side of said tongue while bending the lower lip elastically in a downward direction; and

maintaining said lower lip in a bent condition after such coupling to effectively bias the sloped and inclined portions of the lower lip and tongue together and to produce a resultant biasing force maintaining the panels compressed against each other at the coupled side edges.

4. A method according to claim **3**, wherein said second panel is coupled to the first panel by first fitting the tongue and groove into each other with the second panel angled upwardly with respect to the first panel and then subsequently angling down the second panel to bring the two panels into a coplanar relationship, and causing by said angling down that the bendable portion of the lower lip of the first panel is resiliently bent downwardly over a small distance.

5. The method according to claim **3**, wherein the second panel is coupled to the first panel by first fitting the tongue and groove into each other, said fitting being carried out by shifting the second panel relative to the first panel with both panels in a substantially coplanar relationship, and causing by said shifting that the bendable portion of the lower lip of the first panel is deflected downwardly over a small distance.

6. The method according to claim **3**, wherein said tongue, groove, lips and locking elements are provided on coupling parts located at opposed pairs of opposite side edges, said method comprising the additional step of:

coupling a third one of said panels to the first and second ones of said panels respectively along complementary third and fourth side edges of the panels that extend perpendicular to each other; and causing by said coupling that an elastically bendable portion of a lower lip of the last recited side edges is elastically deflected in a downward direction, the return force of the deflected portion of the lip providing the resultant biasing force maintaining the panels compressed against each other along said third and fourth side edges.

7. The method according to claim **6**, wherein the coupling of the panels is created by the steps of:

coupling the third panel to the first panel by first fitting a tongue of the third panel into a complementary groove of the first panel with the third panel angled upwardly with respect to the first panel, then angling down the third panel so that the first and third panels are coplanar, and causing by said angling down that the bendable portion of the lower lip of the first panel is deflected downwardly over a small distance to provide a resilient biasing force urging said first and third panels together;

coupling the third panel to the second panel by first partially fitting a tongue of the third panel into a complementary groove of the second panel and then shifting the third panel toward the second panel with the second and third panels in a coplanar relationship to fully couple the respective tongue and groove of the third and second panels; said third and second panels being thereby located in a coplanar condition with the bendable portion of the lower lip of the second panel remaining in a downwardly deflected condition to provide a resilient biasing force urging the third and second panels together.

8. The method according to claim **6**, wherein the coupling of the panels is created by the steps of:

coupling the third panel to the first panel by first fully coupling together a tongue and groove of the third and first panels by shifting the third panel relative to first panel with both panels in a coplanar relationship, said shifting causing a bendable portion of the lower lip of the first panel to become and remain deflected downwardly over a small distance while the panels are coupled; and

coupling the third panel to the second panel by coupling the tongue and groove of the respective third and second panels, said coupling being carried out by shifting the third panel relative to the second panel with the panels in a substantially coplanar relationship;

causing the bendable portion of the lower lip of the second panel to become and remain deflected downwardly over a small distance while the third and second panels are coupled.

9. The method according to claim **3**, including the step of laying all the panels over a flexible underlay, said flexible underlay accommodating the downwardly bent portions of the panel lips with the upper surfaces of the panels lying in a common plane.

10. A floor covering comprising

a laminated hard floor panel having a wood-based core material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibreboard (MDF), said panel comprising a first pair and a second pair of opposed side edges,

said panel further comprising generally complementary coupling parts located at both of the pairs of said side edges, said coupling parts comprising a tongue and a groove, said tongue and groove when coupled along adjacent side edges of two ones of said panel comprising integral mechanical locking elements, said coupling parts as well as said mechanical locking elements being integral and made in one piece with said core material,

said coupling parts together with said locking elements arranged so as to enable a locking in a direction perpendicular to the plane of the floor covering as well as in a direction perpendicular to the coupled side edges and parallel to a plane including the panels that are coupled,

wherein said coupling parts and the mechanical locking elements of at least said second pair of opposite side edges are configured such that two identical ones of said floor panel are coupled by shifting them laterally towards each other in a substantial planar fashion, and

wherein the locking elements of said second pair of opposite side edges provide a snap-together coupling providing a snap-action during the coupling of two panels by shifting them laterally towards each other, said snap action being delivered substantially by said core material;

wherein said locking elements comprise a recess located in a lower lip extending at least to a side edge and defining at least in part a lower side of said groove; and a protrusion provided at a lower side of said tongue;

wherein the-panels at the side edge comprising the groove, of at least one of the side edge of both pairs of the side edges, include an upper lip above the groove, said upper lip defining at least in part an upper side of said groove, and said upper lip terminating at a distal outer end, wherein said lower lip extends distally beyond the distal outer end of the upper lip, and further wherein the recess is located in the lower lip in an area of the lower lip that is located at least partly beyond the distal outer end of the upper lip.

11. The floor covering according to claim **10**, wherein the configuration of the tongue and the lower lip are such that a tongue of said panel becomes automatically lodged in the groove of another identical one of said panels by laterally moving the panels towards each other in approximately a plane including the panels during which the tongue is partially inserted into the groove before the lower lip is deformed.

12. The floor covering according to claim **11**, wherein said panel becomes automatically lodged in the groove of another identical one of said panels by laterally moving the panels towards each other in approximately a plane including the panels starting from positions at which the panels are completely separated from each other.

13. The floor covering according to claim **10**, wherein the first pair of side edges as well as the second pair of the side edges comprise coupling parts and locking elements including a lower lip extending beyond the upper lip.

14. The floor covering according to claim **10**, wherein one pair of the side edges comprises coupling parts in the form of a tongue and a groove and wherein the locking elements of this pair of side edges are located completely inside the groove.

15. The floor covering according to claim **14**, wherein the groove is formed by upper and lower lips, the upper lip and the lower lip bordering the groove are of equal length.

16. The floor covering according to claim **15**, wherein said floor panels are elongated and the side edges having the upper lip and the lower lip of equal length is located at one of the short sides of the panels.

17. The floor covering according to claim **10**, wherein the lower lip extends beyond the upper lip over a distance which is smaller than the thickness of the panel.

18. The floor covering according to claim **10**, wherein at at least one pair of the edges, the locking elements comprise inclined contact surfaces.

19. The floor covering according to claim **18**, wherein the contact surfaces define a tangent line which in respect to the plane of the floor covering shows an inclination which is comprised between 30° and 70°.

20. The floor covering according to claim **11**, wherein the locking elements comprise at least one contact surface which is perpendicular to the plane of the panels.

21. The floor covering according to claim **14**, wherein one pair of the side edges comprises coupling parts in the form of a tongue and a groove and wherein the locking elements of this pair of side edges are located completely inside the groove; and wherein the locking elements comprise at least one contact surface which is perpendicular to the plane of the panels.

22. The floor covering according to claim **10**, wherein said lower lip comprises an increasing thickness from the recess towards the innermost point of said groove.

23. A floor covering comprising

a laminated hard floor panel having a wood-based core material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibreboard (MDF), said panel comprising a first pair and a second pair of opposed side edges,

said panel further comprising generally complementary coupling parts located at both of the pairs of said side edges, said coupling parts comprising a tongue and a groove, said tongue and groove when coupled along adjacent side edges of two ones of said panel comprising integral mechanical locking elements, said coupling parts as well as said mechanical locking elements being integral and made in one piece with said core material,

said coupling parts together with said locking elements arranged so as to enable a locking in a direction perpendicular to the plane of the floor covering as well as in a direction perpendicular to the coupled side edges and parallel to a plane including the panels that are coupled,

wherein said coupling parts and the mechanical locking elements of at least said second pair of opposite side edges are configured such that two identical ones of said floor panel are coupled by shifting them laterally towards each other in a substantial planar fashion, and

wherein the locking elements of said second pair of opposite side edges provide a snap-together coupling

providing a snap-action during the coupling of two panels by shifting them laterally towards each other, said snap action being delivered substantially by said core material;

at least one of said pairs of edges comprising a lower lip defining at least in part a bottom side of a groove of said coupling parts and extending distally beyond a respective groove opening, and wherein said locking elements comprise a protrusion extending from the lower side of a tongue of said pairs of edges and a cooperating recess in said lower lip, said protrusion and recess fitting together when ones of said panel are coupled by said tongue and groove;

wherein, when a complementary tongue and groove are coupled, said protrusion and recess meet each other at contiguous contact surfaces at a common plane of tangency that with respect to a common plane of the coupled panels is inclined inwardly from a distally outer area towards a distally inner area at an angle less than 90°.

24. The floor panel according to claim **23**, wherein the angle is between 30–70°.

25. A floor covering comprising

a laminated hard floor panel having a wood-based core material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibreboard (MDF), said panel comprising a first pair and a second pair of opposed side edges,

said panel further comprising generally complementary coupling parts located at both of the pairs of said side edges, said coupling parts comprising a tongue and a groove, said tongue and groove when coupled along adjacent side edges of two ones of said panel comprising integral mechanical locking elements, said coupling parts as well as said mechanical locking elements being integral and made in one piece with said core material,

said coupling parts together with said locking elements arranged so as to enable a locking in a direction perpendicular to the plane of the floor covering as well as in a direction perpendicular to the coupled side edges and parallel to a plane including the panels that are coupled,

wherein said coupling parts and the mechanical locking elements of at least said second pair of opposite side edges are configured such that two identical ones of said floor panel are coupled by shifting them laterally towards each other in a substantial planar fashion, and

wherein the locking elements of said second pair of opposite side edges provide a snap-together coupling providing a snap-action during the coupling of two panels by shifting them laterally towards each other, said snap action being delivered substantially by said core material;

at least one of said pairs of edges comprising a lower lip defining at least in part a bottom side of a groove of said coupling parts and extending distally beyond a respective groove opening, and wherein said locking elements comprise a protrusion extending from the lower side of a tongue of said pairs of edges and a cooperating recess in said lower lip, said protrusion and recess fitting together when ones of said panel are coupled by said tongue and groove;

said panel including an upper outer edge and wherein the protrusion and recess include engageable complementary contact surfaces located on radii (R1–R2) centered within a circle which extends within a radius of 3 mm around the upper outer edge of the panel.

26. A method of assembling a floor covering comprising hard floor panels of rectangular shape, said panels each including complementary coupling parts at opposed side edges of the panels, said coupling parts arranged to cooperate with complementary coupling parts of another one of said panel, said coupling parts comprising substantially a tongue, a groove, and integrated locking elements collectively arranged to prevent the drifting apart of two coupled ones of said floor panel in a direction parallel to the edges along which the panels are coupled and parallel to a plane including the floor panels, said panels each including distally extending upper and lower lips on opposite sides of said groove, said lower lip including an elastically flexible portion and defining at least in part a lower side of the groove and extending distally beyond the upper lip, and wherein one of said locking elements comprises at least in part a portion of the elastically flexible portion of the lower lip that extends beyond the upper lip and which is inclined downwardly in a direction extending inwardly from the distal end area of said lip, said locking element cooperating with a surface of the lower side of the tongue which slopes downwardly in a direction extending outwardly from a proximal area of the tongue toward a distal area thereof, said method comprising the steps of:

laying a first one of said hard floor panel on a support surface;

placing a second one of said panel next to a side edge of the first one of said panel, such that a tongue of one of said panel side edges lies next to a groove of the other one of said panel side edges;

shifting the panels towards each other to move a tongue into a groove and to bend a flexible portion of a lower lip downwardly, said shifting causing the inclined and sloped surfaces of the tongue and groove respectively to engage each other in coupled relationship with the panels biased towards each other by the returning force of the downwardly bent lower lip;

wherein a third panel is coupled to a previously laid one or more of said first and second ones of said panel by placing the tongue of the third panel in a complementary groove of one or more of the previously laid panels, and wherein the second one of said panel, before being coupled with the first one of said panel, is coupled to an already previously laid one or more of said panel using the steps of:

directing a tongue of the third one of said panel towards a groove of an already laid panel or panels and inserting a tongue of the third one of said panel at least partially into the groove of an already laid panel or panels while the third one panel is angled upwardly relative to the already laid panel or panels;

angling down the third one of said panel so that the inclined locking elements are brought adjacent each other;

after such angling down of the third one of said panel, laterally moving the third one of said panel towards the previously laid one or more panels with the panels in a common plane to completely engage the tongue, groove and locking elements of the third one of said panel with a complementary tongue, groove and locking element of the previously laid panel or panels.

27. A floor covering comprising

a laminated hard floor panel having a wood-based core material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibre-

board (MDF), said panel comprising a first pair and a second pair of opposed side edges,

said panel further comprising generally complementary coupling parts located at both of the pairs of said side edges, said coupling parts comprising a tongue and a groove, said tongue and groove when coupled along adjacent side edges of two ones of said panel comprising integral mechanical locking elements, said coupling parts as well as said mechanical locking elements being integral and made in one piece with said core material,

said coupling parts together with said locking elements arranged so as to enable a locking in a direction perpendicular to the plane of the floor covering as well as in a direction perpendicular to the coupled side edges and parallel to a plane including the panels that are coupled,

wherein said coupling parts and the mechanical locking elements of at least said second pair of opposite side edges are configured such that two identical ones of said floor panel are coupled by shifting them laterally towards each other in a substantial planar fashion, and

wherein the locking elements of said second pair of opposite side edges provide a snap-together coupling providing a snap-action during the coupling of two panels by shifting them laterally towards each other, said snap action being delivered substantially by said core material;

wherein said coupling parts and locking elements of the first pair of side edges are configured and dimensioned so as to enable two identical ones of said floor panel to be coupled at the side edges at least by turning one of said floor panels relative to the other.

28. The floor covering according to claim **27**, wherein said coupling parts and locking elements of the first pair of side edges are configured and dimensioned so as to enable identical ones of said floor panel to be laterally coupled at these side edges exclusively by turning one of said floor panels relative to the other.

29. The floor covering according to claim **27**, wherein said floor panels are elongated and the first pair of opposed side edges is formed by the longer side edges, whereas the second pair of opposed side edges is formed by the shorter side edges.

30. The floor covering according to claim **27**, wherein said coupling parts and said locking elements of both of the pairs of side edges are configured and dimensioned so as to enable identical ones of said floor panel to be laterally engaged, as well as disengaged, at their side edges by turning one of said floor panel relative to the other.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,490,836 B1
DATED : December 10, 2002
INVENTOR(S) : Moriau et al.

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

The title page showing the illustrative figure should be deleted, and substituted therefore the new title page with the illustrated figure attached.

Drawings,
The drawing sheets 1-4 & 9, consisting of figures 3, 5, 8, 11, 22 & 23, should be deleted to be replaced with the drawing sheets 1-4 & 9, consisting of figures 3, 5, 8, 11, 22 & 23, as shown on the attached sheets.

Signed and Sealed this

Twenty-fourth Day of June, 2003

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

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

(10) **Patent No.: US 6,490,836 B1**
(45) **Date of Patent: *Dec. 10, 2002**

(54) **FLOOR PANEL WITH EDGE CONNECTORS**

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(73) Assignee: **Unilin Beheer B.V. Besloten Vennootschap**, Nieuwerkerk A/D Ijssel (NL)

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/471,014**

(22) Filed: **Dec. 23, 1999**

Related U.S. Application Data

(63) Continuation of application No. 08/872,044, filed on Jun. 10, 1997, now Pat. No. 6,006,486.

(30) **Foreign Application Priority Data**

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Apr. 15, 1997 (BE) 09700344

(51) **Int. Cl.**[7] **E04B 2/08**

(52) **U.S. Cl.** **52/589.1**; 52/592.1; 52/586.1; 52/590.2; 52/592.3

(58) **Field of Search** 52/578.1, 589.1, 52/592.1, 590.2, 592.7, 586.1, 570, 572, 591.1, 590.1

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Primary Examiner—Yvonne M. Horton
(74) *Attorney, Agent, or Firm*—Bacon & Thomas

(57) **ABSTRACT**

Floor covering, including hard floor panels (1) which, at least at the edges of two opposite sides (2–3, 26–27), are provided with coupling parts (4–5, 28–29), cooperating which each other, substantially in the form of a tongue (9–31) and a groove (10–32), wherein the coupling parts (4–5, 28–29) are provided with integrated mechanical locking elements (6) which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges (2–3, 26–27) and parallel to the underside (7) of the coupled floor panels (1).

30 Claims, 10 Drawing Sheets

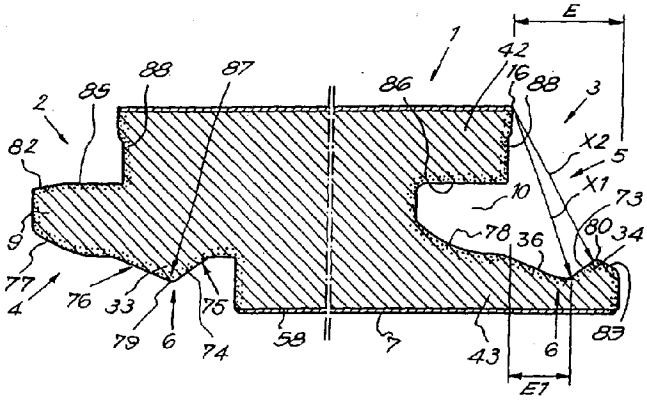
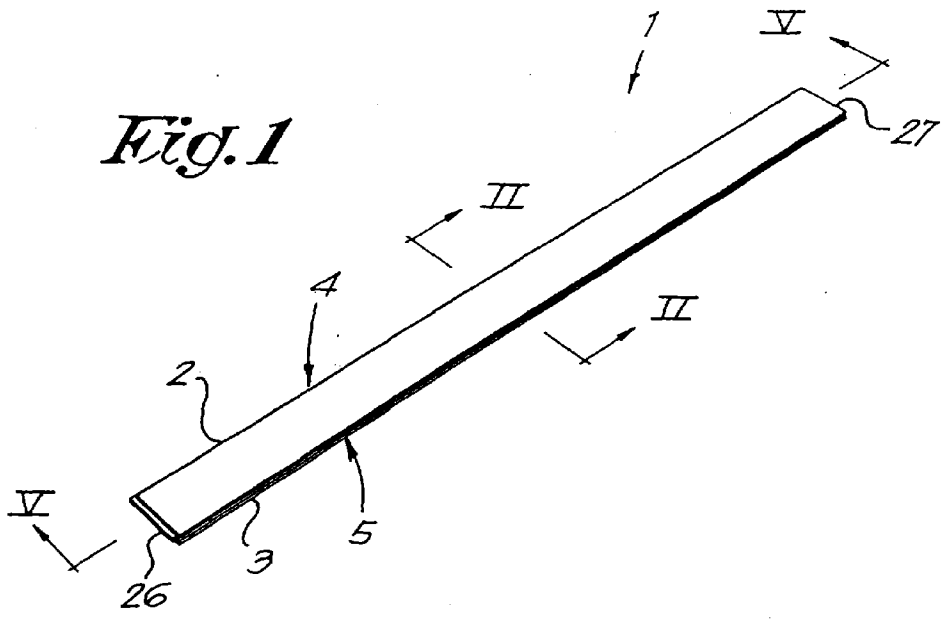


Fig. 1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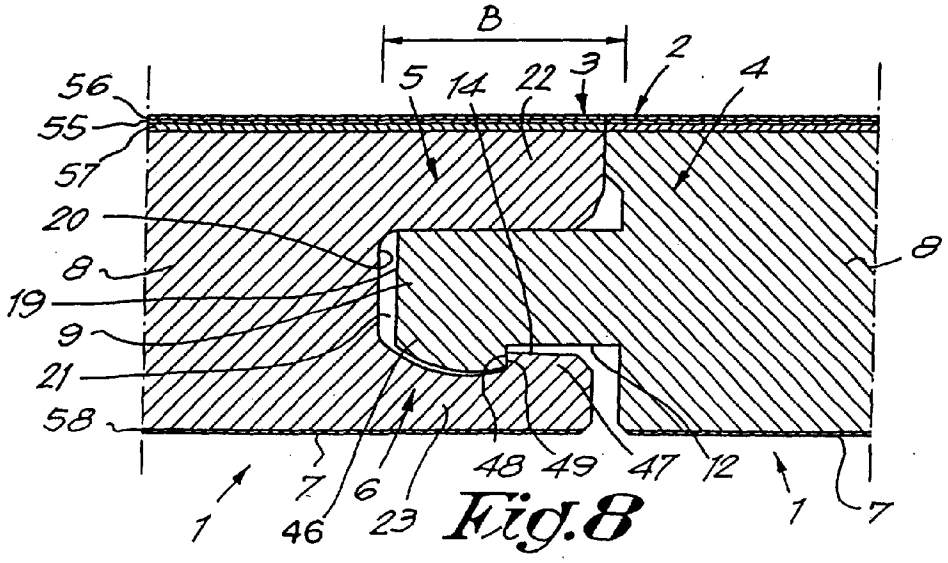
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Fig. 8

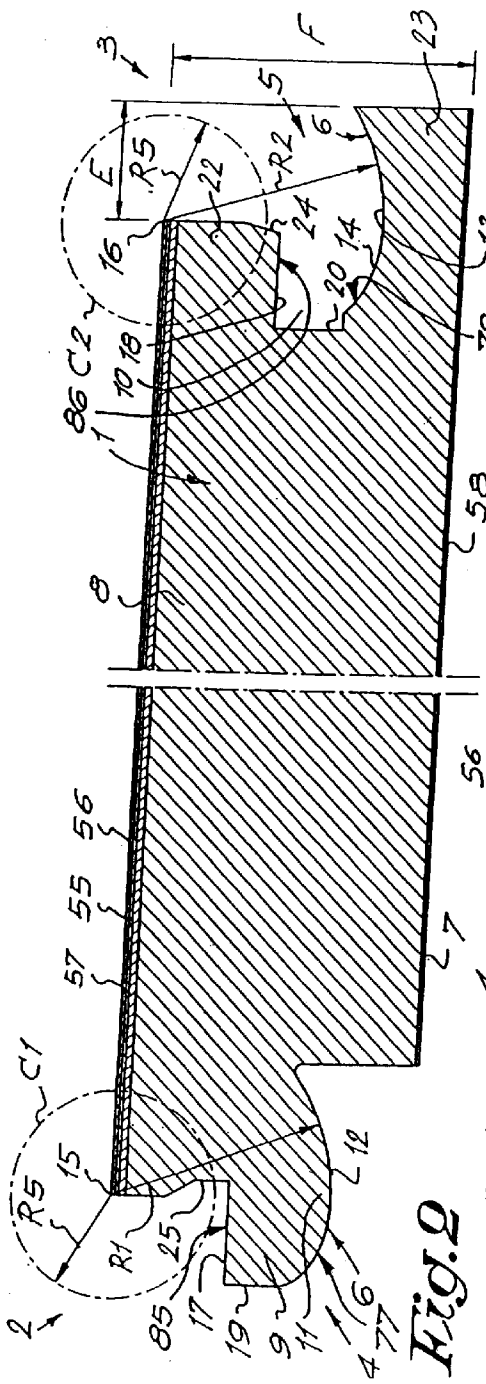


Fig.2

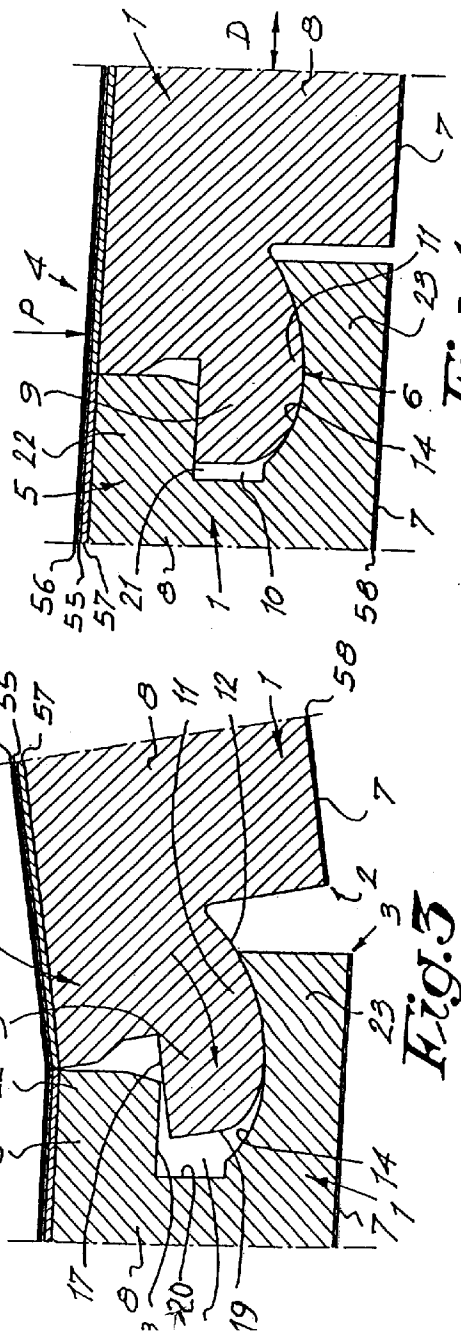
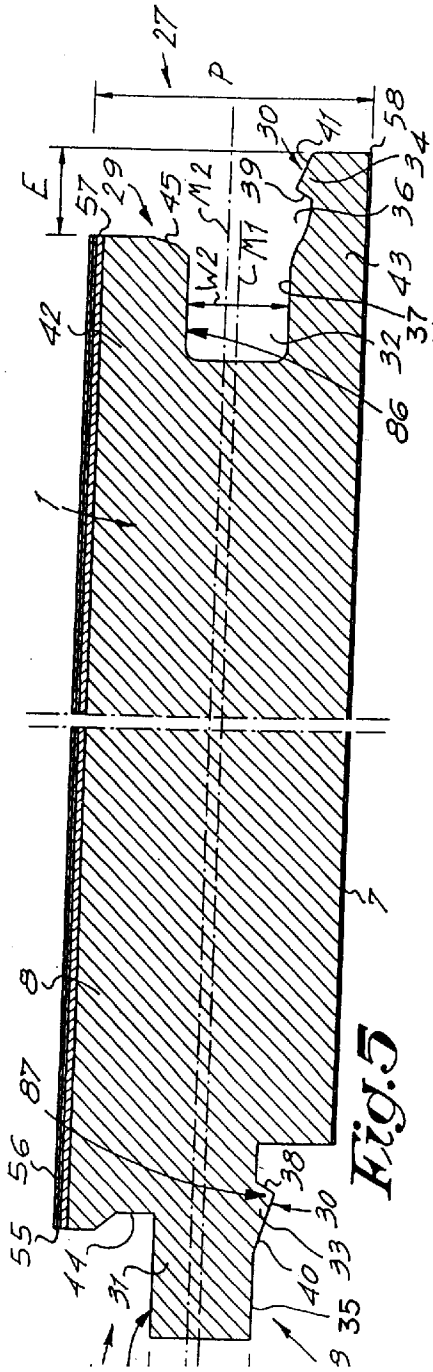


Fig.3

Fig.4



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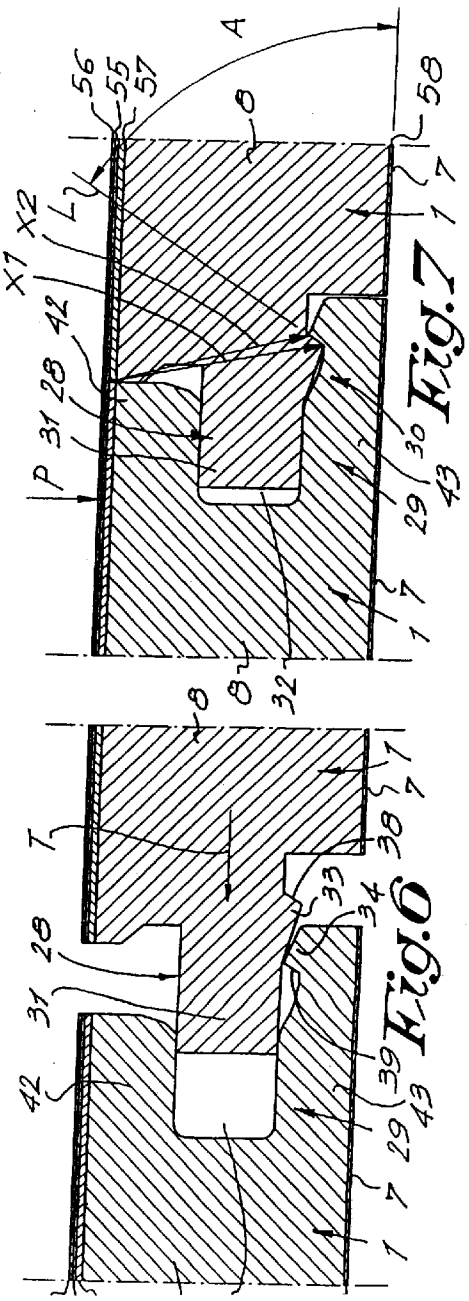
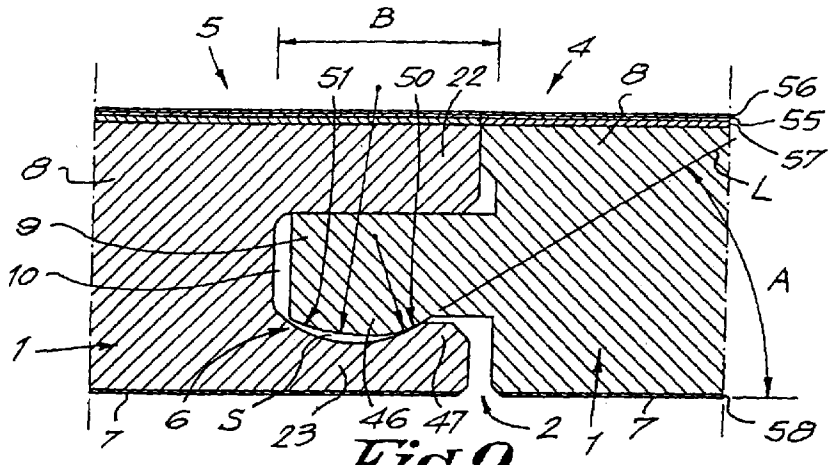


Fig.7

Fig.6



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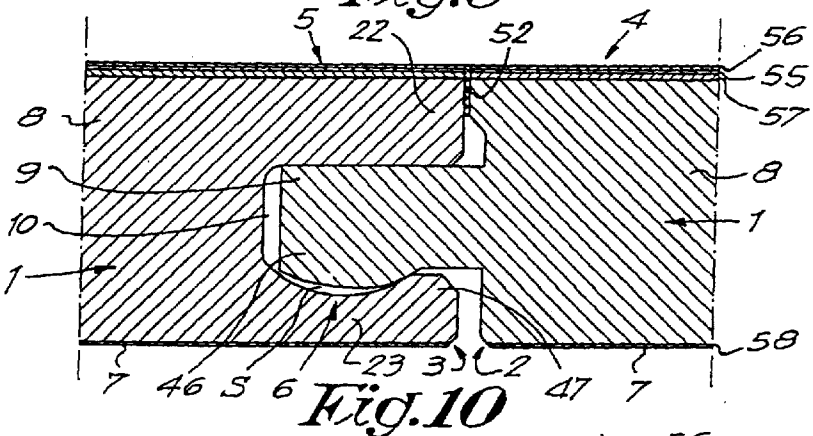


Fig.10

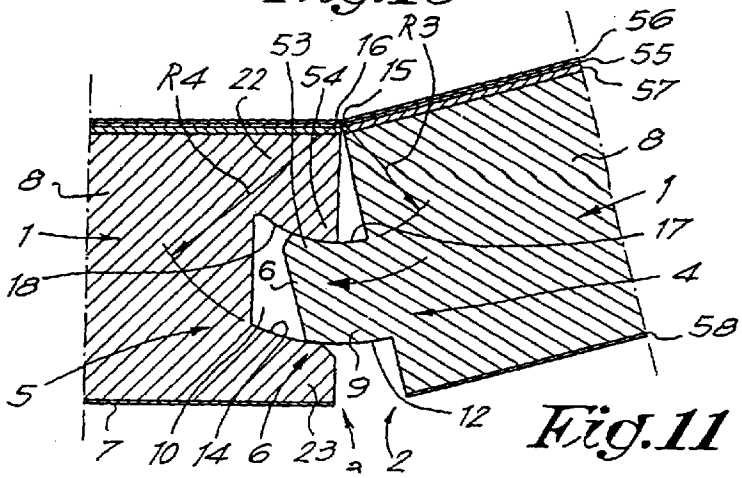
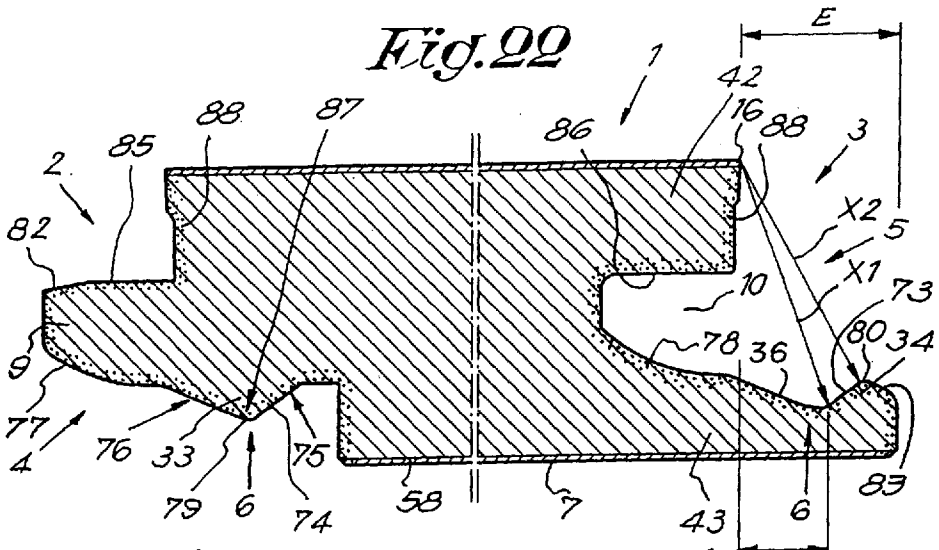


Fig.11

Fig.22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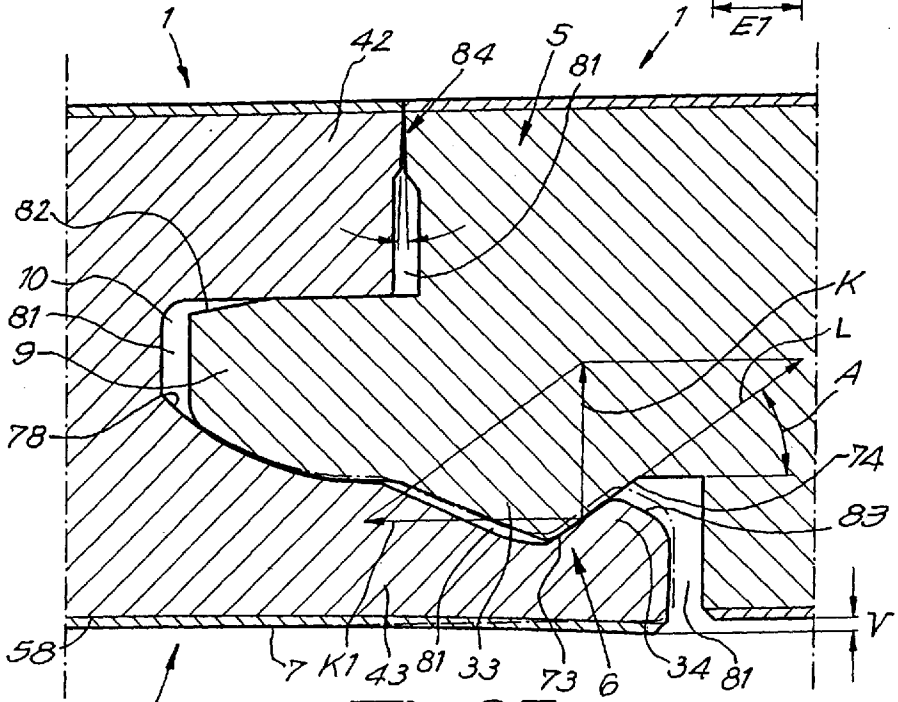
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Fig.23