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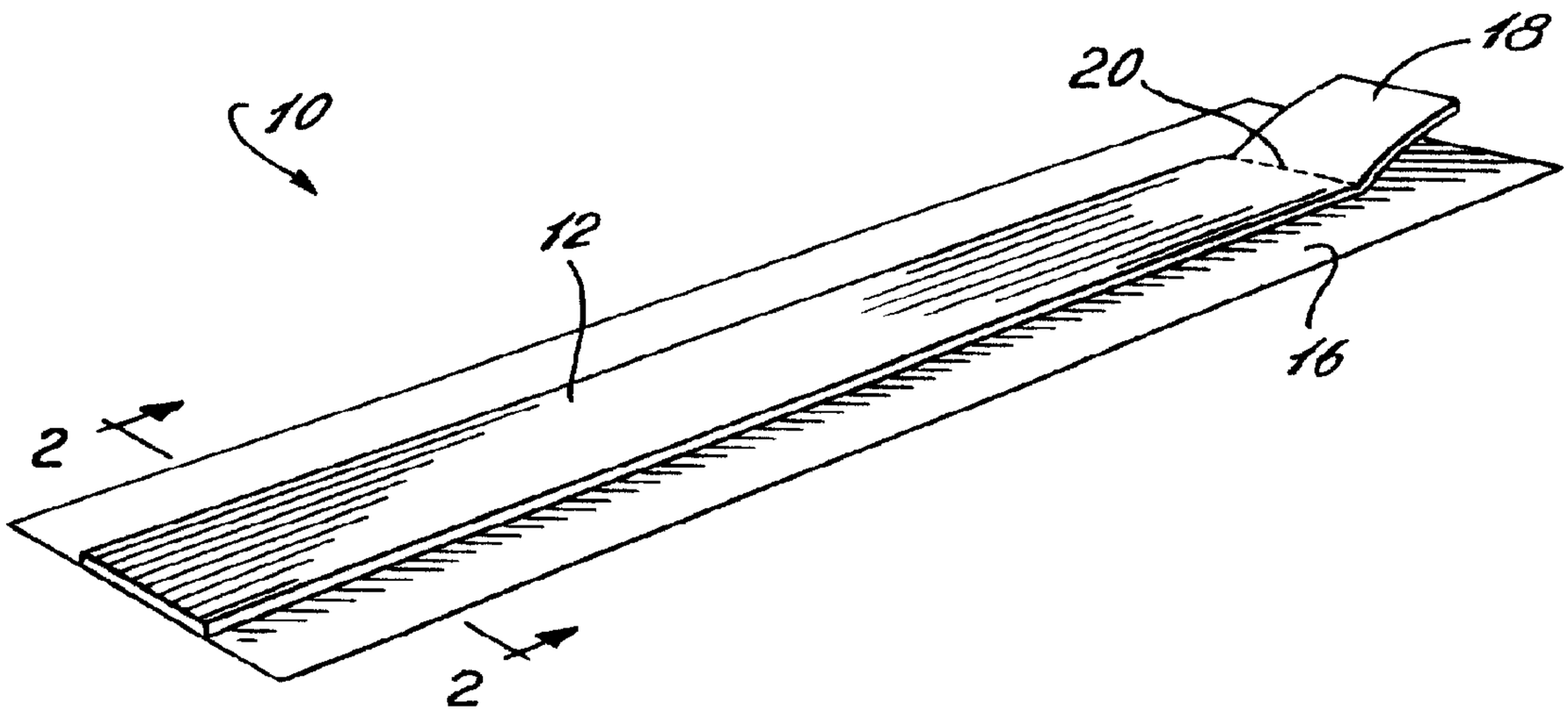
(54) Titre : BANDE DE SUTURE ADHESIVE
(54) Title: ADHESIVE SUTURE STRIP



(57) Abrégé/Abstract:
An adhesive suture strip for closing a wound on a patient comprises an elongated, flexible radiation-transmitting backing member having opposite ends, first and second surfaces facing away from one another and a length and width sufficient to secure facing edges of the wound in close juxtaposition to one another, the backing member comprising a first portion disposed between the ends and adapted to overlie the facing edges of the wound, and second and third portions disposed on either side of the first portion; a pressure-sensitive adhesive and a radiation-curable adhesive coated on at least part of the first surface of the backing member including the second and third portions thereof, the pressure-sensitive adhesive serving to adhere at least the second and third portions of the backing member to the patient with the facing edges of the wound in close juxtaposition, and the radiation-curable adhesive serving to strengthen the adhesion of the second and third portions of the backing member to the patient. The suture strip according to the invention further includes a protective member removably attached to the backing member and covering the pressure-sensitive adhesive and the radiation-curable adhesive. After removal of the protective member to expose the pressure-sensitive adhesive and radiation-curable adhesive, application of the backing member with the exposed pressure-sensitive adhesive onto the patient to secure the facing edges of the wound in close juxtaposition and irradiation of the backing member with curing radiation, the exposed radiation-curable adhesive upon curing together with the backing member maintain the facing edges of the wound in close juxtaposition.

ABSTRACT

An adhesive suture strip for closing a wound on a patient comprises an elongated, flexible radiation-transmitting backing member having opposite ends, first and second surfaces facing away from one another and a length and width sufficient to secure facing edges of the wound in close juxtaposition to one another, the backing member comprising a first portion disposed between the ends and adapted to overlie the facing edges of the wound, and second and third portions disposed on either side of the first portion; a pressure-sensitive adhesive and a radiation-curable adhesive coated on at least part of the first surface of the backing member including the second and third portions thereof, the pressure-sensitive adhesive serving to adhere at least the second and third portions of the backing member to the patient with the facing edges of the wound in close juxtaposition, and the radiation-curable adhesive serving to strengthen the adhesion of the second and third portions of the backing member to the patient. The suture strip according to the invention further includes a protective member removably attached to the backing member and covering the pressure-sensitive adhesive and the radiation-curable adhesive. After removal of the protective member to expose the pressure-sensitive adhesive and radiation-curable adhesive, application of the backing member with the exposed pressure-sensitive adhesive onto the patient to secure the facing edges of the wound in close juxtaposition and irradiation of the backing member with curing radiation, the exposed radiation-curable adhesive upon curing together with the backing member maintain the facing edges of the wound in close juxtaposition.

"ADHESIVE SUTURE STRIP"

The present invention pertains to improvements in the field of wound closing. More particularly, the invention relates to an improved adhesive suture strip for closing a wound on a patient.

When closing a wound, it is necessary to join and keep together the facing edges of the wound. If the separated skin sections are sewn, unesthetical scars may remain, and if they are stapled, such scars generally remain.

Cyanoacrylate-based adhesives have been suggested as an alternative to sutures. When a cyanoacrylate adhesive is employed, the separated skin sections are joined and the adhesive is applied on top of the joined sections under sterile conditions. The cyanoacrylate adhesive bonds to the skin and polymerizes so as to keep together the joined sections. Although cyanoacrylate adhesives successfully bind the skin, the use of such adhesives as suture replacements can be accompanied by occasional adhesion failure resulting in wound reopening which requires closure by sutures. Fear of wound reopening is one of the reasons physicians have been reluctant to use any surgical adhesive including cyanoacrylate-based adhesives instead of sutures. Moreover, since the procedure of wound closing with a surgical adhesive is effected in one single step, it is important that the best possible wound closing be achieved at the first attempt.

U.S. Patent No. 5,254,132 proposes a method of treating suturable wounds by first suturing or stapling the wound and then joining the skin between sutures or staples with a cyanoacrylate adhesive. According to this method, the wound is sutured or stapled so that the sutures or staples are separated from each other by no more than about 1.2 centimeter and no less than about 0.6 centimeter. 2-Butylcyanoacrylate is then applied to the opposing and still separated skin sections between the sutures or staples in an amount sufficient so that upon polymerization the skin sections are joined; the application is conducted so that contact of the cyanoacrylate adhesive with the sutures or staples is avoided. The adjacent separated skin sections are thereafter contacted under conditions that permit the adhesive to polymerize so as to join the separated skin sections. Such a method is not only time-consuming and

requires particular skill to practice, but also delays healing of the wound if cyanoacrylate adhesive penetrates in between the skin sections.

Surgical adhesive strips for closing wounds are also known. These strips generally do not have much tensile strength so that their use is limited to shallow wounds requiring little tension to close. Another major disadvantage resides in their permeability to water, causing the strips to become unstuck upon contact with water or moisture and thereby preventing the wounded area from being washed.

It is therefore an object of the present invention to overcome the above drawbacks and to provide an improved adhesive suture strip enabling a physician to close a wound in a manner such that the separated skin sections can be joined temporarily to achieve the best possible wound closing and the joined sections can thereafter be permanently secured together.

According to the invention, there is provided an adhesive suture strip for closing a wound on a patient, comprising:

an elongated, flexible radiation-transmitting backing member having opposite ends, first and second surfaces facing away from one another and a length and width sufficient to secure facing edges of the wound in close juxtaposition to one another, the backing member comprising a first portion disposed between the ends and adapted to overlie the facing edges of the wound, and second and third portions disposed on either side of the first portion;

a pressure-sensitive adhesive and a radiation-curable adhesive coated on at least part of the first surface of the backing member including the second and third portions thereof, the pressure-sensitive adhesive serving to adhere at least the second and third portions of the backing member to the patient with the facing edges of the wound in close juxtaposition, and the radiation-curable adhesive serving to strengthen the adhesion of the second and third portions of the backing member to the patient; and

a protective member removably attached to the backing member and covering the pressure-sensitive adhesive and radiation-curable adhesive.

After removal of the protective member to expose the pressure-sensitive adhesive and the radiation-curable adhesive, application of the backing member with the exposed pressure-sensitive adhesive onto the patient to secure the facing edges of the wound in close juxtaposition and irradiation of the backing member with curing radiation, the exposed radiation-curable adhesive upon curing together with the backing member maintain the facing edges of the wound in close juxtaposition.

Applicant has found quite unexpectedly that by using a radiation-transmitting backing member having a pressure-sensitive adhesive and a radiation-curable adhesive coated on at least part of the first surface of the backing member including the second and third portions thereof, to close a wound, the separated skin sections can be joined temporarily by means of the pressure-sensitive adhesion to achieve the best possible wound closing. Once this is achieved, the backing member is then irradiated with curing radiation to cause curing of the radiation-curable adhesive. The latter adhesive upon curing strengthens the adhesion of the second and third portions of the backing member to the patient so as to maintain the facing edges of the wound in close juxtaposition.

The backing member must be made of a material which allows the curing radiation to pass therethrough. Examples of suitable radiation-transmitting material include low density polyethylene and blends of low density polyethylene and high density polyethylene. It is also possible to use a non-woven fabric material such as cotton, rayon or polyester. The backing member is of course air-permeable to enable the skin to breathe. The protective member, on the other hand, preferably comprises a film of high density polyethylene or a sheet of wax paper.

According to a preferred embodiment of the invention, a layer of the pressure-sensitive adhesive in admixture with the radiation curable adhesive completely covers the first surface of the backing member.

According to another preferred embodiment, a plurality of spaced-apart dots of radiation-curable adhesive are provided only on the second and third

portions of the backing member. The pressure-sensitive adhesive is provided on the first surface of the backing member between the dots of radiation-curable adhesive.

According to a further preferred embodiment, a plurality of spaced-apart strips of radiation-curable adhesive are provided only on the second and third portions of the backing member, the strips of radiation-curable adhesive extending transversely of the backing member. The pressure-sensitive adhesive is provided on the first surface of the backing member between the strips of radiation-curable adhesive.

Generally, the dots or strips of surgical adhesive define a total area representing from about 10 to about 50%, preferably from about 15 to about 30%, of the area defined by the first surface of the backing member.

According to yet another preferred embodiment, a finger-grip tab is detachably connected to the backing member at one of the ends thereof along a tear-line extending transversely of the backing member. Such a tab enables one to pull the backing member away from the protective member and thereby remove the latter to expose the adhesives on the backing member. After the suture strip has been applied onto the patient's skin, the tab is torn away. Preferably, the protective member is substantially coextensive with the backing member along the length thereof and the tab, and extends beyond opposite side edges of the backing member and tab.

Examples of suitable pressure-sensitive adhesive include elastomers such as polybutadiene and styrene-butadiene copolymers. A tackifying agent such as a saturated thermoplastic resinous polymer is preferably admixed with the elastomer to improve the tackiness and wetting characteristics thereof.

When the curing radiation used is ultraviolet light generally having a wavelength of about 200 to about 390 nm, the radiation-curable adhesive preferably comprises a mixture of an acrylate ester monomer and an initiator responsive to the ultraviolet light for inducing curing of the acrylate ester monomer. Use is preferably made of methylmethacrylate, 2-n-butoxy

ethylmethacrylate or 1,6-hexanedioldiacrylate. The initiator is preferably an aromatic carbonyl compound such as 1-hydroxyclycloxyl phenylketone. A co-initiator responsive to the ultraviolet light can be added to the mixture comprising the acrylate ester monomer and initiator for assisting the initiator in inducing curing of the acrylate ester monomer. For example, a tertiary amine such as triethylamine can be used as co-initiator.

Preferably, the mixture comprising the acrylate ester monomer and initiator further includes an oligomer such as polyurethane for improving the viscosity of the radiation-curable adhesive as well as the mechanical properties thereof. In order to prevent undesirable hardening of the cured adhesive, a plasticizer such as a phthalate or lanoline can be added to the mixture. For example, use can be made of dioctylphalate. On the other hand, if the cured adhesive is too soft, a thickener such as polyethylene glycol or polymethylmethacrylate can be added to the mixture. A stabilizer such as hydroquinone or 2-hydroxy-4-methoxybenzophenone can also be added for improving the shelf-life of the adhesive.

When the curing radiation is visible light generally having a wavelength of about 390 to about 650 nm, the radiation-curable adhesive preferably comprises a mixture of an acrylate ester monomer, an initiator and a co-initiator responsive to the visible light for inducing curing of the acrylate ester monomer. Use is preferably made of methylmethacrylate, 2-n-butoxy ethylmethacrylate or 1,6-hexanedioldiacrylate. Preferably, the initiator is an organic dye such as methylene blue and the co-initiator is a tertiary amine, such as triethylamine. The initiator can also be a titanocene such as fluorinated diaryltitanocene; the co-initiator is preferably N,N-dimethylaniline.

The visible light-curable adhesive can also further comprise the same oligomer, plasticizer, tickener and/or stabilizer as in the UV-curable adhesive.

Further features and advantages of the present invention will become more readily apparent from the following description of preferred embodiments as illustrated by way of examples in the accompanying drawings, in which:

Figure 1 is a perspective view of an adhesive suture strip according to a preferred embodiment of the invention;

Figure 2 is a sectional view taken along line 2-2 of Fig. 1;

Figure 3 is a perspective view of an adhesive suture strip according to another preferred embodiment of the invention;

Figure 4 is a fragmentary bottom plan view of a backing member according to a preferred embodiment, shown provided with a plurality of spaced-apart dots of radiation-curable adhesive;

Figure 5 is a fragmentary bottom plan view of a backing member according to another preferred embodiment, shown also provided with a plurality of spaced-apart dots of radiation-curable adhesive;

Figure 6 is a fragmentary bottom plan view of a backing member according to a further preferred embodiment, shown provided with a plurality of spaced-apart strips of radiation-curable adhesive; and

Figure 7 is a fragmentary bottom plan view of a backing member according to yet another preferred embodiment, shown also provided with a plurality of spaced-apart strips of radiation-curable adhesive.

Referring first to Figs. 1 and 2, there is illustrated an adhesive suture strip which is generally designated by reference numeral 10 and used for closing a wound on a patient (not shown). The suture strip 10 comprises an elongated, flexible and radiation-transmitting backing member 12 having a wound facing surface coated with a layer of pressure-sensitive adhesive in admixture with a radiation-curable adhesive. The backing member 12 has a length and width sufficient to secure facing edges of the wound in close juxtaposition to one another. A protective member 16 is removably attached to the backing member 12 and covers the adhesive layer 14. A finger-grip tab 18 is detachably connected to the backing member 12 at one end thereof along a tear-line 20 extending transversely of the member 12. As shown, the protective

member 16 is substantially coextensive with the backing member 12 along the length thereof and the tab 18, and extends beyond opposite side edges of the member 12 and tab 18.

The embodiment 10' illustrated in Fig. 3 is similar to that shown in Fig. 1, with the exception that a much wider protective member 16' is used to accommodate a plurality of backing members 12 coated with pressure-sensitive adhesive and radiation-curable adhesive.

Turning to Figs. 4 and 5, the backing member 12 instead of having a continuous coating of pressure-sensitive and radiation-curable adhesives, is provided on its wound facing surface 22 with a plurality of spaced-apart dots 24 of radiation-curable adhesive. The backing member 12 has a substantially central portion 12a adapted to overlie the facing edges of a wound and two portions 12b,12c disposed on either side of the portion 12a. In the embodiment of Fig. 4, the dots 24 of radiation-curable adhesive are provided only on the portions 12b and 12c of the backing member 12 whereas, in the embodiment of Fig. 5, they are provided on all portions 12a, 12b and 12c. A pressure-sensitive adhesive 26 is provided on the surface 22 between the dots 24 of radiation-curable adhesive.

The embodiments illustrated in Figs. 6 and 7 are similar to those illustrated in Figs. 4 and 5, respectively, with the exception that instead of dots of radiation-curable adhesive a plurality of spaced-apart strips 28 of radiation-curable adhesive are provided on the surface 22 of the backing member 12. As shown, the strips 28 of radiation-curable adhesive extend transversely of the backing member 12.

In use, the protective member 16 is first peeled-off to expose the pressure-sensitive and radiation-curable adhesives on the wound facing surface of the backing member 12, while holding the tab 18 with one's fingers. The end portion of the backing member 12 opposite the tab 18 is adhered by means of the pressure-sensitive adhesive to one of the separated skin sections, which is then pulled in a direction towards the other separated skin section to bring the facing edges of the wound in close juxtaposition with one another, and the

other end portion of the member 12 adjacent the tab 18 is adhered by means of the pressure-sensitive adhesive to the other skin section, thereby closing the wound and securing the facing edges thereof in close juxtaposition. If the wound closing is not satisfactory, the wound can be easily re-opened by partially or completely taking off the backing member 12 and repositioning it to achieve the best possible wound closing. Once this is achieved, the backing member 12 is then irradiated with curing radiation to cause curing of the radiation-curable adhesive. The latter adhesive upon curing strengthens the adhesion of the end portions 12b,12c to the patient's skin in the case of the embodiments shown in Figs. 4 and 6, and of the entire backing member 12 in the case of the embodiments shown in Figs. 1, 5 and 7. Thus, the cured adhesive together with the backing member 12 maintain the facing edges of the wound in close juxtaposition. The tab 18 is thereafter torn along the tear-line 20.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An adhesive suture strip for closing a wound on a patient, comprising:

an elongated, flexible radiation-transmitting backing member having opposite ends, first and second surfaces facing away from one another and a length and width sufficient to secure facing edges of the wound in close juxtaposition to one another, said backing member comprising a first portion disposed between said ends and adapted to overlie the facing edges of said wound, and second and third portions disposed on either side of said first portion;

a pressure-sensitive adhesive and a radiation-curable adhesive coated on at least part of the first surface of said backing member including said second and third portions thereof, said pressure-sensitive adhesive serving to adhere at least said second and third portions of said backing member to the patient with the facing edges of the wound in said close juxtaposition, and said radiation-curable adhesive serving to strengthen the adhesion of said second and third portions of said backing member to the patient; and

a protective member removably attached to said backing member and covering said pressure-sensitive adhesive and said radiation-curable adhesive;

whereby after removal of said protective member to expose said pressure-sensitive adhesive and said radiation-curable adhesive, application of said backing member with the exposed pressure-sensitive adhesive onto the patient to secure the facing edges of said wound in said close juxtaposition and irradiation of said backing member with curing radiation, the exposed radiation-curable adhesive upon curing together with said backing member maintain the facing edges of said wound in said close juxtaposition.

2. A suture strip according to claim 1, wherein a layer of said pressure-sensitive adhesive in admixture with said radiation-curable adhesive completely covers the first surface of said backing member.

3. A suture strip according to claim 1, wherein a plurality of spaced-apart dots of said radiation-curable adhesive are provided only on the second and third portions of said backing member, and wherein said pressure-sensitive adhesive is provided on the first surface of said backing member between said dots of radiation-curable adhesive.

4. A suture strip according to claim 1, wherein a plurality of spaced-apart dots of said radiation-curable adhesive are provided on the first, second and third portions of said backing member, and wherein said pressure-sensitive adhesive is provided on the first surface of said backing member between said dots of radiation-curable adhesive.

5. A suture strip according to claim 3 or 4, wherein the first surface of said backing member has a predetermined area and wherein said dots of radiation-curable adhesive define a total area representing from about 10 to about 50% of said predetermined area.

6. A suture strip according to claim 3 or 4, wherein the first surface of said backing member has a predetermined area and wherein said dots of radiation-curable adhesive define a total area representing from about 15 to about 30% of said predetermined area.

7. A suture strip according to claim 1, wherein a plurality of spaced-apart strips of said radiation-curable adhesive are provided only on the second and third portions of said backing member, said strips of radiation-curable adhesive extending transversely of said backing member, and wherein said pressure-sensitive adhesive is provided on the first surface of said backing member between said strips of radiation-curable adhesive.

8. A suture strip according to claim 1, wherein a plurality of spaced-apart strips of said radiation-curable adhesive are provided on the first, second and third portions of said backing member, said strips of radiation-curable adhesive extending transversely of said backing member, and wherein said pressure-

sensitive adhesive is provided on the first surface of said backing member between said strips of radiation-curable adhesive.

9. A suture strip according to claim 7 or 8, wherein the first surface of said backing member has a predetermined area and wherein said strips of radiation-curable adhesive define a total area representing from about 10 to about 50% of said predetermined area.

10. A suture strip according to claim 7 or 8, wherein the first surface of said backing member has a predetermined area and wherein said strips of radiation-curable adhesive define a total area representing from about 15 to about 30% of said predetermined area.

11. A suture strip according to any one of claims 1 to 10, wherein said pressure-sensitive adhesive comprises an elastomer.

12. A suture strip according to claim 11, wherein said elastomer is polybutadiene or a styrene-butadiene copolymer.

13. A suture strip according to claim 11 or 12, wherein said pressure-sensitive adhesive comprises a mixture of said elastomer and a tackifying agent.

14. A suture strip according to claim 13, wherein said tackifying agent is a saturated thermoplastic resinous polymer.

15. A suture strip according to any one of claims 1 to 14, wherein said curing radiation is ultraviolet light.

16. A suture strip according to claim 15, wherein said radiation-curable adhesive comprises a mixture of an acrylate ester monomer and an initiator responsive to said ultraviolet radiation for inducing curing of said acrylate ester monomer.

17. A suture strip according to claim 16, wherein said acrylate ester monomer is selected from the group consisting of methylmethacrylate, 2-n-butoxy ethylmethacrylate and 1,6-hexanedioldiacrylate.

18. A suture strip according to claim 16 or 17, wherein said initiator is an aromatic carbonyl compound.

19. A suture strip according to claim 18, wherein said aromatic carbonyl compound is 1-hydroxyclycloxyl phenylketone.

20. A suture strip according to any one of claims 16 to 19, wherein said mixture comprising said acrylate ester monomer and said initiator further includes a co-initiator responsive to said ultraviolet light for assisting said initiator in inducing curing of said acrylate ester monomer.

21. A suture strip according to claim 20, wherein said co-initiator is a tertiary amine.

22. A suture strip according to claim 21, wherein said tertiary amine is triethylamine.

23. A suture strip according to any one of claims 16 to 22, wherein said mixture comprising said acrylate ester monomer and said initiator further includes an oligomer.

24. A suture strip according to claim 23, wherein said oligomer is polyurethane.

25. A suture strip according to any one of claims 16 to 24, wherein said mixture comprising said acrylate ester monomer and said initiator further includes a plasticizer.

26. A suture strip according to claim 25, wherein said plasticizer is a phthalate.

27. A suture strip according to claim 25, wherein said plasticizer is lanoline.

28. A suture strip according to any one of claims 16 to 24, wherein said mixture comprising said acrylate ester monomer and said initiator further includes a thickener.

29. A suture strip according to claim 33, wherein said thickener is polyethylene glycol or polymethylmethacrylate.

30. A suture strip according to any one of claims 16 to 29, wherein said mixture comprising said acrylate ester monomer and said initiator further includes a stabilizer.

31. A suture strip according to claim 30, wherein said stabilizer is hydroquinone or 2-hydroxy-4-methoxybenzophenone.

32. A suture strip according to any one of claims 1 to 14, wherein said curing radiation is visible light.

33. A suture strip according to claim 32, wherein said radiation-curable adhesive comprises a mixture of an acrylate ester monomer, an initiator and a co-initiator responsive to said visible light for inducing curing of said acrylate ester monomer.

34. A suture strip according to claim 33, wherein said acrylate ester monomer is selected from the group consisting of methylmethacrylate, 2-n-butoxy ethylmethacrylate and 1,6-hexanedioldiacrylate.

35. A suture strip according to claim 33 or 34, wherein said initiator is an organic dye and said co-initiator is a tertiary amine.

36. A suture strip according to claim 35, wherein said organic dye is methylene blue and said tertiary amine is triethylamine.

37. A suture strip according to claim 33 or 34, wherein said initiator is a titanocene and said co-initiator is a tertiary amine.

38. A suture strip according to claim 37, wherein said titanocene is fluorinated diaryltitanocene and said tertiary amine is N,N-dimethylaniline.

39. A suture strip according to any one of claims 33 to 38, wherein said mixture comprising said acrylate ester monomer, said initiator and said co-initiator further include an oligomer.

40. A suture strip according to claim 39, wherein said oligomer is polyurethane.

41. A suture strip according to any one of claims 33 to 40, wherein said mixture comprising said acrylate ester monomer, said initiator and said co-initiator further include a plasticizer.

42. A suture strip according to claim 41, wherein said plasticizer is a phthalate.

43. A suture strip according to claim 41, wherein said plasticizer is lanoline.

44. A suture strip according to any one of claims 33 to 40, wherein said mixture comprising said acrylate ester monomer, said initiator and said co-initiator further include a thickener.

45. A suture strip according to claim 44, wherein said thickener is polyethylene glycol or polymethylmethacrylate.

46. A suture strip according to any one of claims 33 to 40, wherein said mixture comprising said acrylate ester monomer, said initiator and said co-initiator further include a stabilizer.

47. A suture strip according to claim 46, wherein said stabilizer is hydroquinone or 2-hydroxy-4-methoxybenzophenone.

48. A suture strip according to any one of claims 1 to 47, wherein said backing member is formed of a non-woven fabric material.

49. A suture strip according to any one of claims 1 to 48, wherein said protective member comprises a film of high density polyethylene or a sheet of wax paper.

50. A suture strip according to any one of claims 1 to 49, wherein a finger-grip tab is detachably connected to said backing member at one of said ends thereof along a tear-line extending transversely of said backing member.

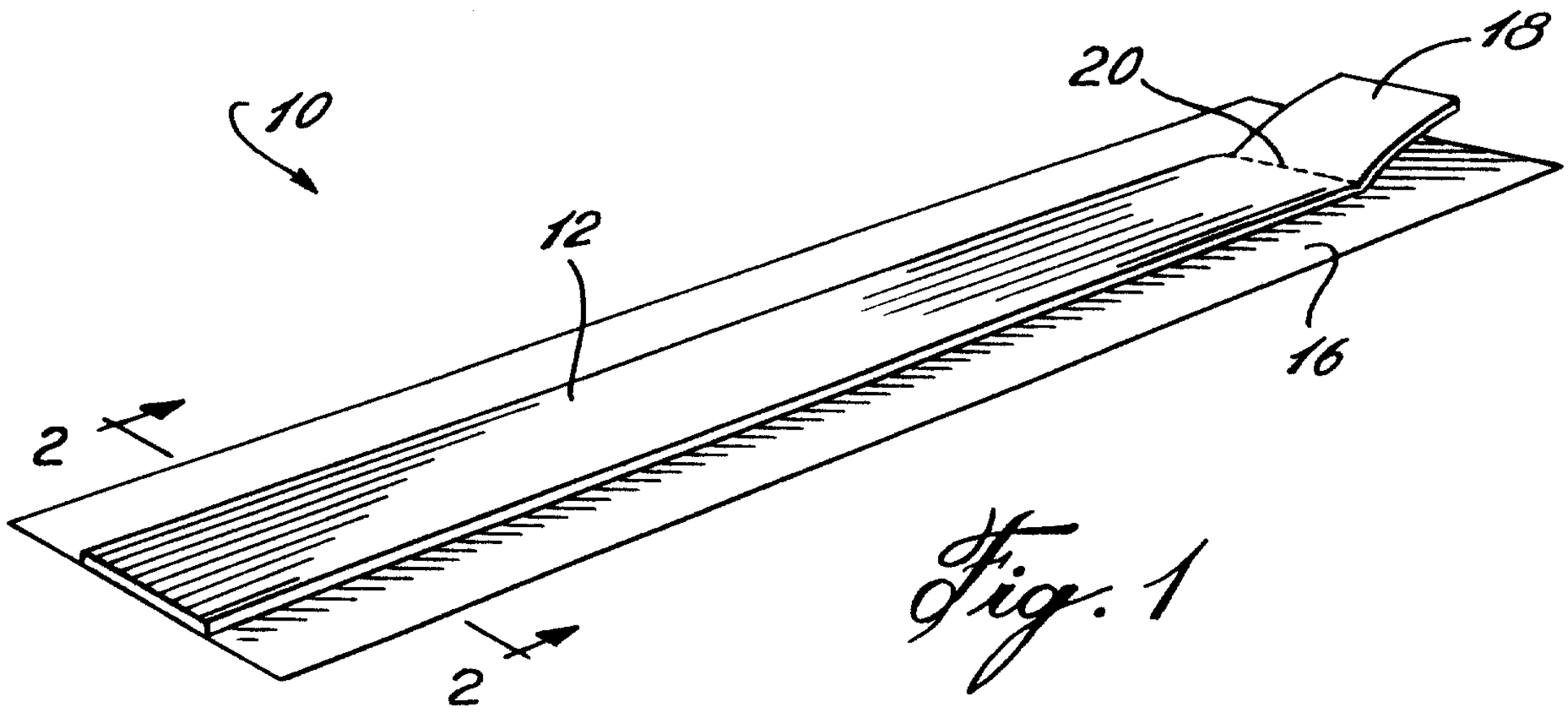


Fig. 1

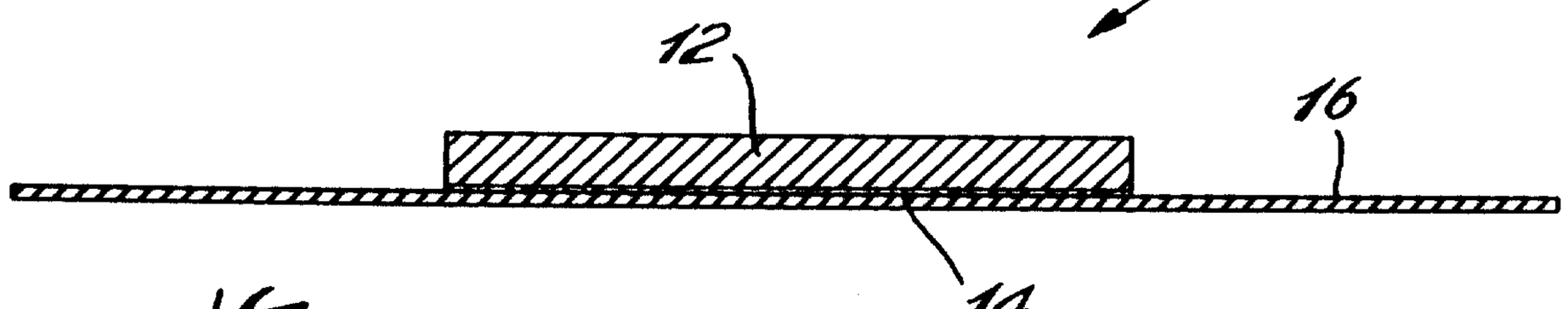


Fig. 2

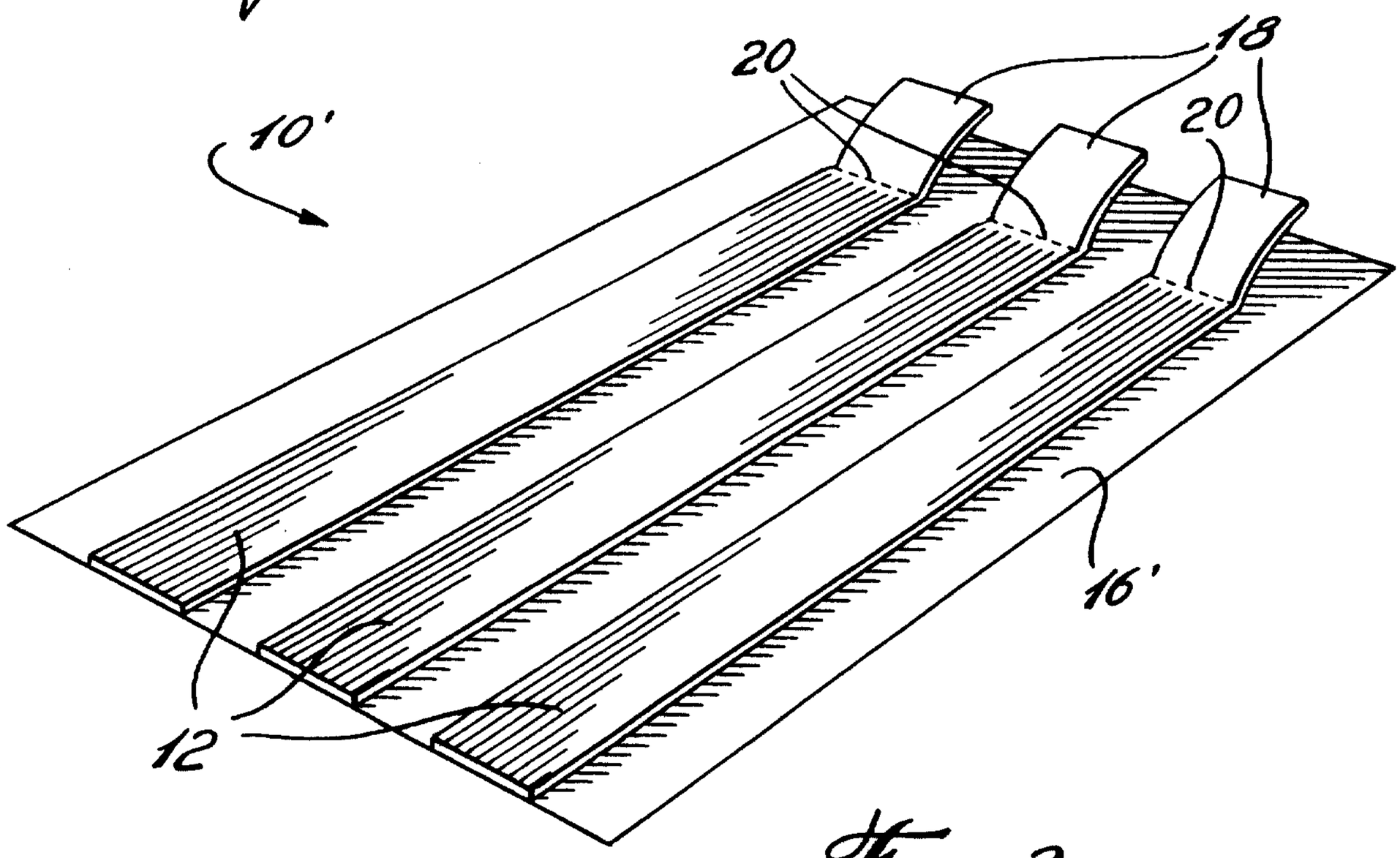


Fig. 3

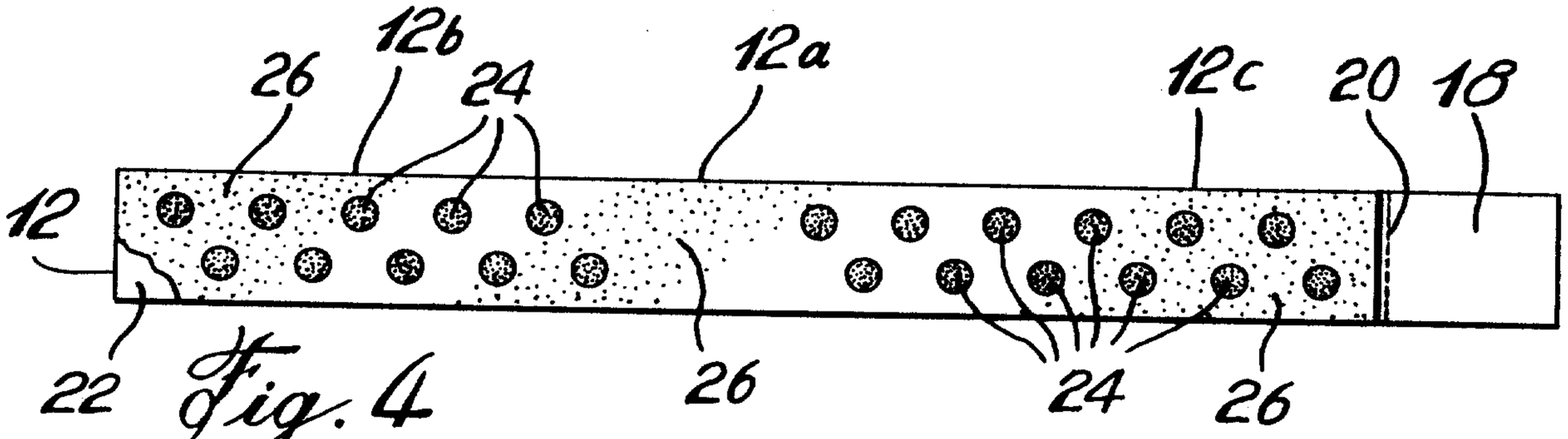


Fig. 4

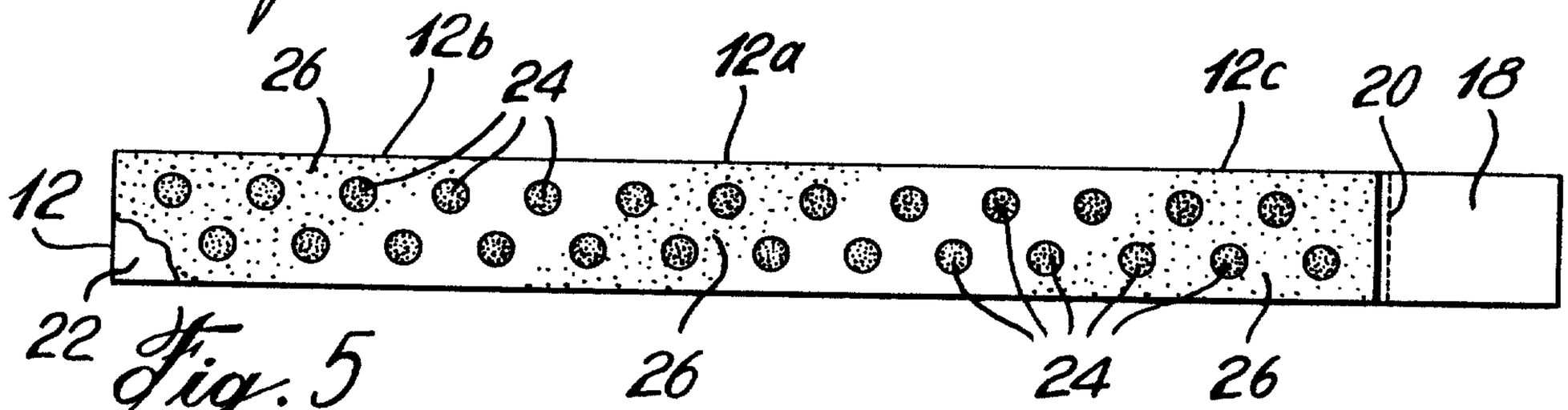


Fig. 5

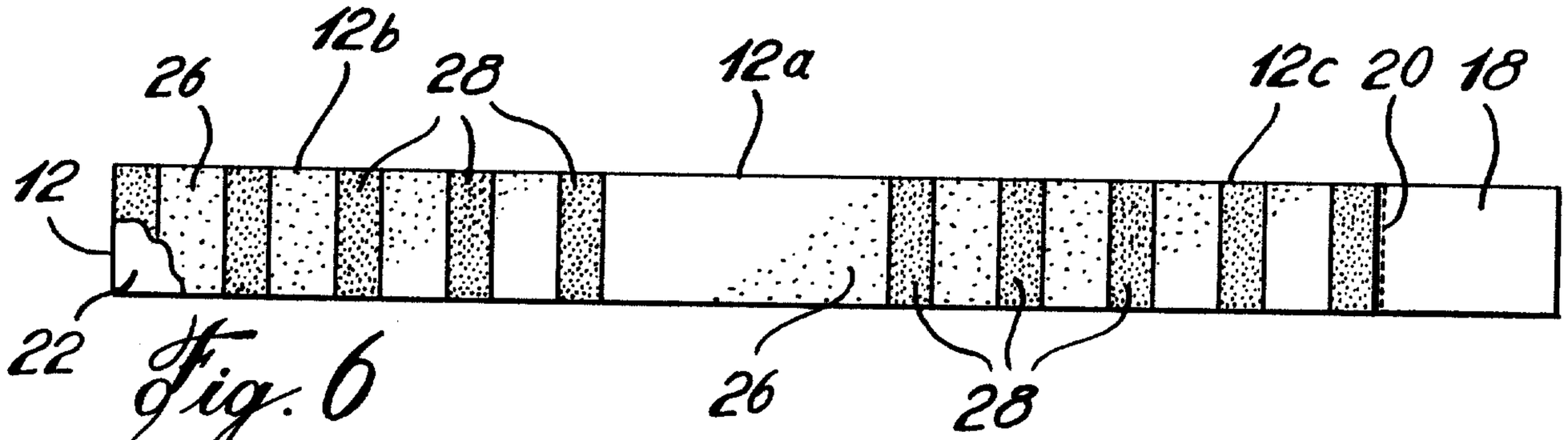


Fig. 6

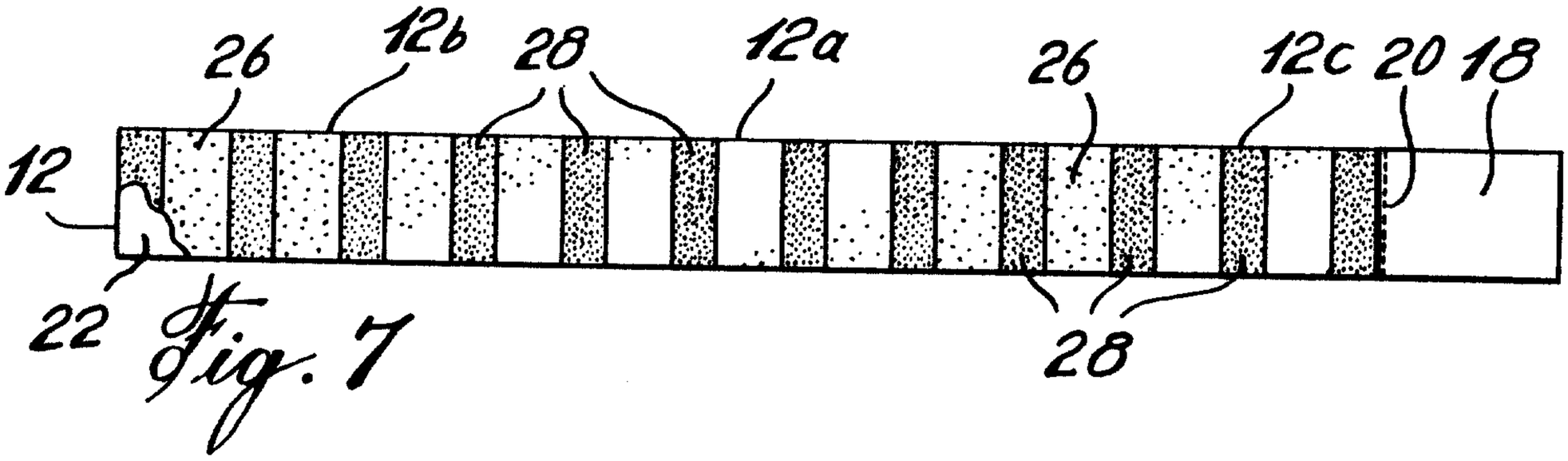
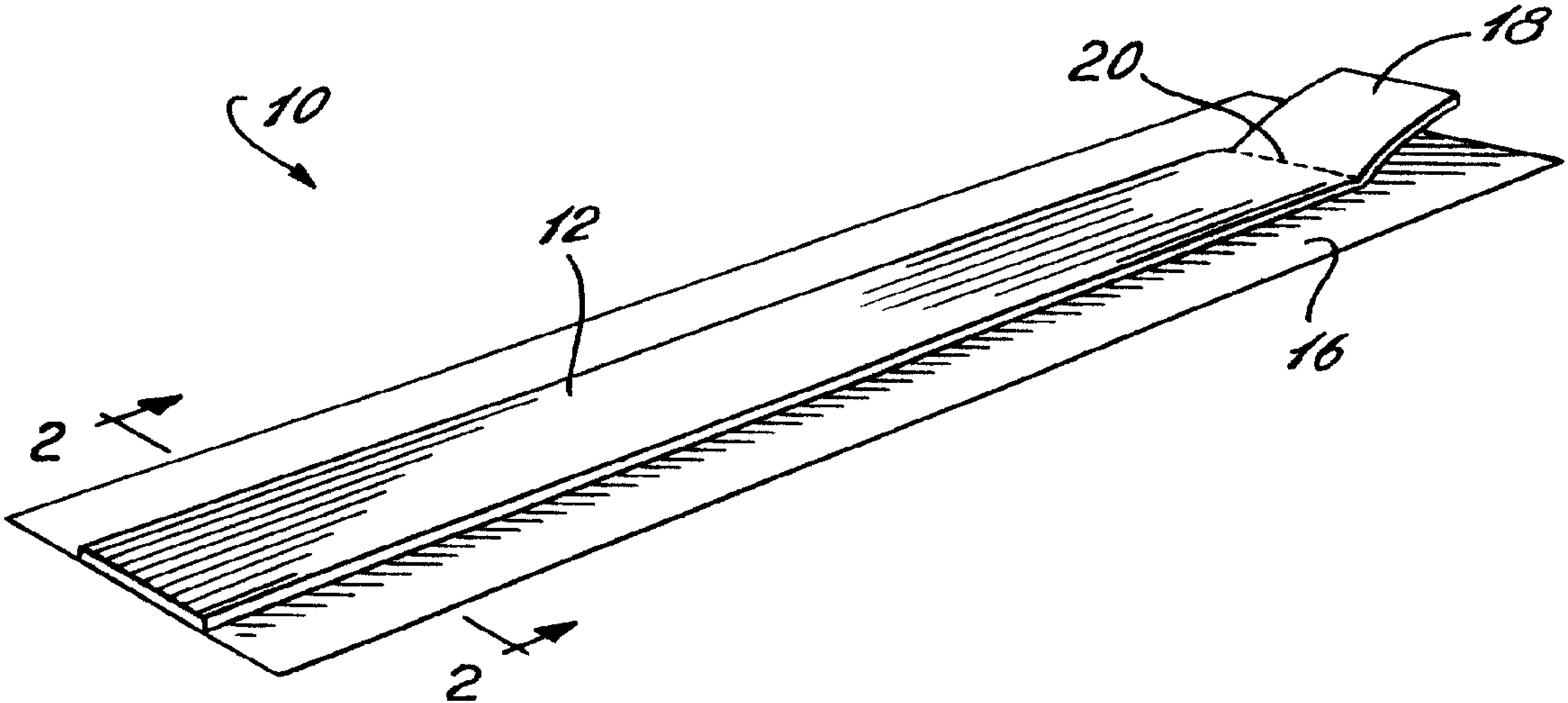


Fig. 7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