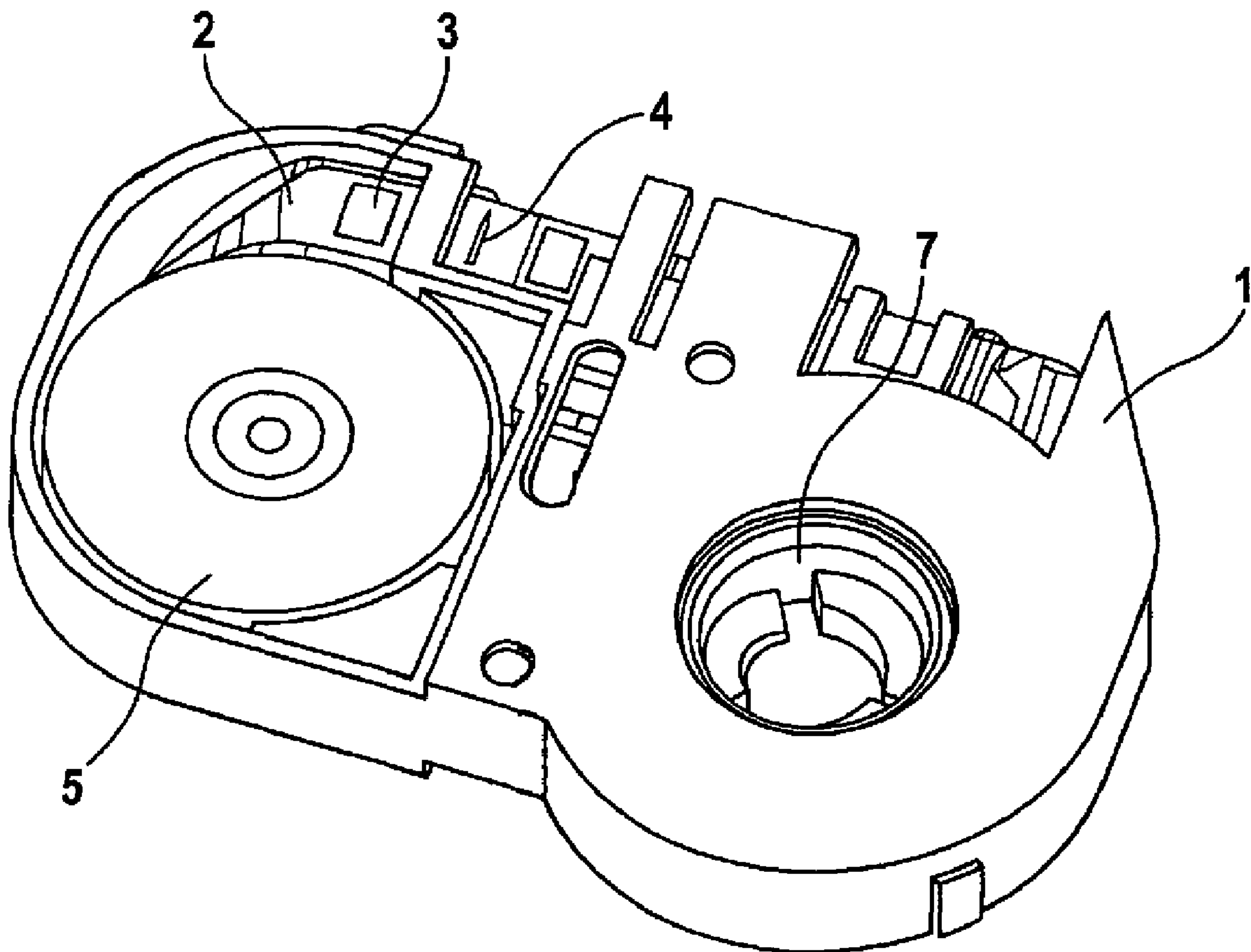




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(54) **Titre : CASSETTE DE BANDE MAGNETIQUE ET SON PROCEDE DE FABRICATION**
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(57) **Abrégé/Abstract:**

The invention relates to a tape cassette having a reeled-up carrier tape (2) that carries at least one type of functional elements, namely test elements (3) and/or puncturing elements (4), that are arranged at a distance from each other in tape direction. The



(57) Abrégé(suite)/Abstract(continued):

invention provides the distances in tape direction from a functional element (3, 4) to the next functional element (3, 4) of the same type to change periodically in space at a period P. Moreover, the invention relates to a method for manufacture of a tape cassette of this type.

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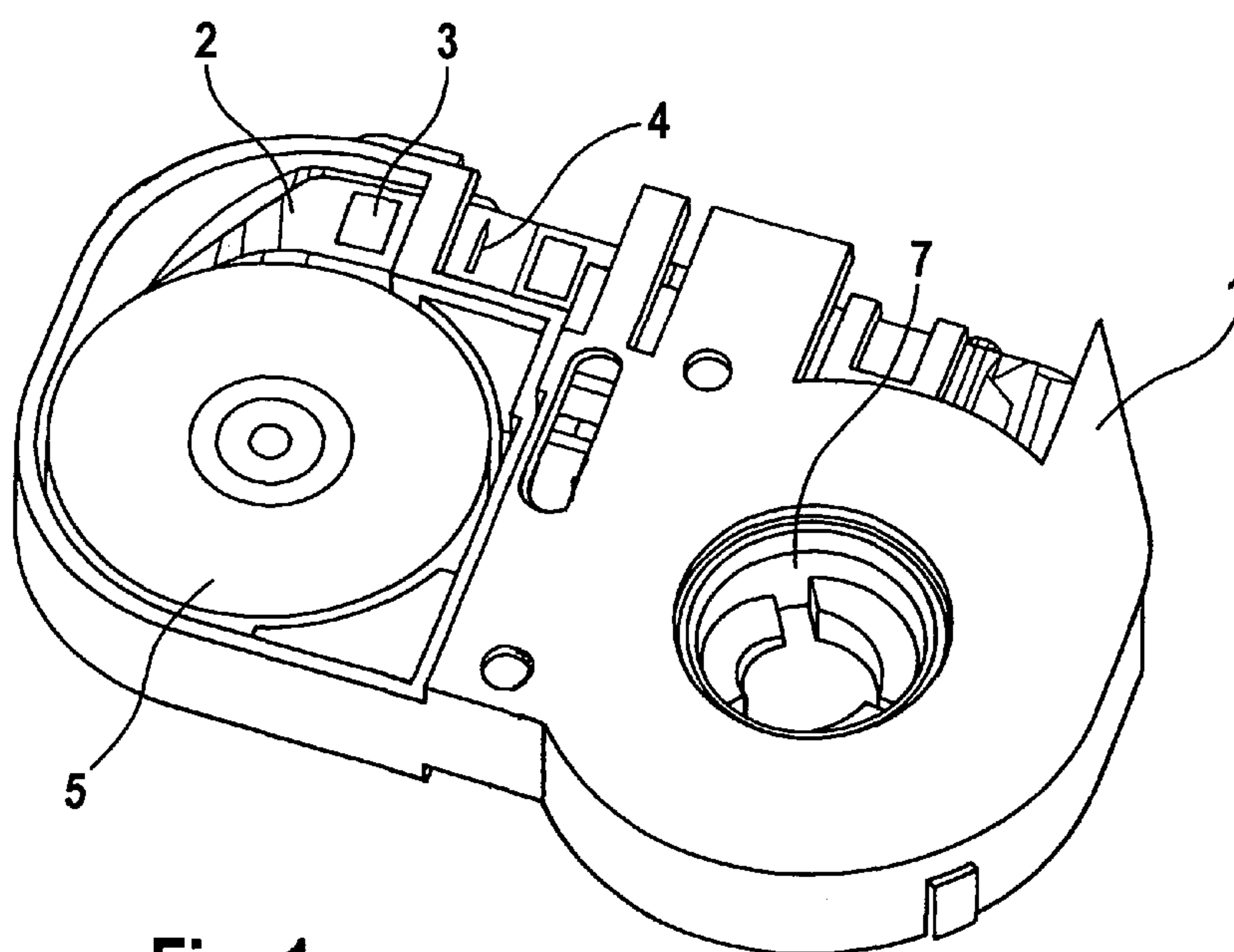
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[Continued on next page]

(54) Title: TAPE CASSETTE AND METHOD FOR THE MANUFACTURE THEREOF

**Fig. 1**

(57) Abstract: The invention relates to a tape cassette having a reeled-up carrier tape (2) that carries at least one type of functional elements, namely test elements (3) and/or puncturing elements (4), that are arranged at a distance from each other in tape direction. The invention provides the distances in tape direction from a functional element (3, 4) to the next functional element (3, 4) of the same type to change periodically in space at a period P. Moreover, the invention relates to a method for manufacture of a tape cassette of this type.

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Tape cassette and method for the manufacture thereof

Description

30 The invention is related to a tape cassette having a reeled-up carrier tape that carries test elements.

Tape cassettes of this type are part of systems for measuring analyte concentrations in body fluid. Systems of this type are needed, for example, by diabetics who have to
35 measure the glucose content of a sample of body fluid, typically blood and/or interstitial fluid, several times daily. Lactate or hemoglobin concentrations, for example, are other analyte concentrations that can be measured with systems of this type.

A carrier tape of such tape cassettes can carry test elements, for example test fields
40 with detection reagents, and/or puncturing elements as functional elements. In the case of tape cassettes designed for devices that are strictly measuring devices, the carrier tape carries only one type of functional elements, namely test elements. Likewise, only a single type of functional elements, namely puncturing elements, is ar-

ranged on the carrier tape of a tape cassette for a system that is strictly a puncturing system. In the case of integrated measuring and puncturing devices, two types of functional elements can be arranged on a carrier tape, namely test elements as first type and puncturing element as second type. Moreover, in the case of tape cassettes
5 for integrated measuring and puncturing devices it is also feasible to arrange only a single type of functional elements on the carrier tape, namely puncturing elements with integrated test elements.

One advantage of tape cassettes is that a very large number of functional elements,
10 for example 50 or even more test elements, can be arranged on a carrier tape that is reeled up in the tape cassette.

It is an object of the present invention to devise a way that allows the number of test elements contained in a tape cassette to be increased without enlarging the tape
15 cassette.

In a tape cassette according to the invention, the distances in tape direction from one
20 test element to the test element of the same type change periodically in space at a period P .

In a tape cassette according to the invention, the test elements are not arranged at constant distances from each other. Rather, the distances in tape direction from a
25 test element to the next test element change periodically such that the distances between a test element and the next test element are repeated after a given number of test elements, i.e. after a given number of identical functional elements.

Reeling up a conventional carrier tape on which functional elements are arranged at
30 constant distances, it can happen that test elements are situated directly over each other in the reeled-up carrier tape. In this case, the reeled-up carrier tape can form an imperfectly round reel that has a larger radius in places, in which many test ele-

ments are situated over each other, as compared to other places. The design space available in a tape cassette is utilized poorly by an imperfectly round reel of this type. The measure according to the invention, being that the distances in tape direction from one test element to the next test element change periodically in space, allows a more even distribution of functional elements in circumferential direction of a carrier tape reel to be attained. The cross-section of the reeled-up carrier tape is therefore closer to the ideal circular shape such that the space available in the cassette can be utilized better.

10 Accordingly, the present invention relates, for example, to a tape cassette having a reeled-up carrier tape that carries test elements, whereby the distances in tape direction from one test element to the next test element change periodically in space at a period of P . The carrier tape can also, in addition, carry puncturing elements. It is also feasible to provide the test elements as integrated puncturing and test elements.

15

Moreover, the invention relates to a tape cassette having a reeled-up carrier tape that carries uniformly oriented puncturing elements, whereby the distances in tape direction from one puncturing element to the next puncturing element change periodically in space at a period of P . Uniformly oriented puncturing elements all point in the same direction with respect to the tape. Said with other word, uniformly oriented puncturing elements all point to the same edge of a tape, e.g. all puncturing elements point to the same lateral edge or all puncturing elements point in tape direction, for example all to the forward edge or end of the tape.

20

25 An advantageous refinement of the invention provides the distances between functional elements of the same type within period P to change by more than the length of a functional element as measured in tape direction. This means that the largest distance from a functional element to the next functional element of the same type differs from the smallest distance between two functional elements of the same type by more than the length of one functional element as measured in tape direction.

30

Another advantageous refinement of the invention provides the distances, in tape direction and within period P , from a functional element to the next functional element of the same type to vary by at least 5%, preferably by at least 10%. Accordingly, with-

in period P, the difference between the largest distance and the smallest distance from a functional element to the next functional element of the same type is at least 5% of the smallest distance, preferably at least 10%, in particular at least 15%.

- 5 What can be attained by means of the measures described above is that the distances between identical puncturing elements, i.e. puncturing elements of the same type, vary strongly enough to effect a more even distribution of functional elements in circumferential direction in a reeled-up carrier tape.
- 10 Another advantageous refinement of the invention provides the difference, within period P, between the largest distance and the smallest distance from a functional element to the next functional element of the same type to be no more than 50%, preferably no more than 40%, in particular no more than 30% of the smallest distance. Unnecessarily large variations of the distance between consecutive functional elements of the same type do not lead to improved reeling properties of the tape, but
15 mainly result in poorer utilization of the carrier tape such that an unnecessarily small number of functional elements per unit length are arranged on the carrier tape.

Another advantageous refinement of the invention provides a period P to comprise at
20 least three functional elements of the same type, e.g. at least three test elements. This means that the distances between consecutive functional elements of the same type are repeated after three or more functional elements of the same type. Although improved reeling properties of the carrier tape can also be attained by means of a shorter period that comprises just two functional elements of the same type, i.e. just
25 two different distances, the variation options with a period being this short are low such that there are limits with regard to the possible improvement of the reeling properties of a carrier tape.

Another advantageous refinement of the invention provides a period to comprise at
30 most 10, preferably at most 8, even more preferably at most 6, in particular at most 5 functional elements of the same type. Namely, if a faulty functional element is placed on the carrier tape or a functional element is arranged in an incorrect position during the production process, it is feasible to cut an entire period, which includes the faulty test element, from the carrier tape and connect the two tape ends thus generated to

each other, for example by gluing or welding them together. In this case, the loss of functional elements is the larger the more functional elements are included in a period. Limiting the number of identical functional elements in a period to at most 10, preferably at most 6, in particular at most 5 functional elements, allows unnecessary production losses to be prevented and good reeling properties of the carrier tape to still be attained. It is particularly advantageous to have, for example, 3 to 5 functional elements of the same type per period.

The periodical arrangement of the functional elements on the carrier tape refers to the nominal positions of the functional elements that are the aim in the production process. Obviously, production tolerances cannot be prevented altogether in the scope of a production process such that the actual positions of the functional elements vary from the nominal positions by the production tolerances. These deviations from the nominal positions are distributed randomly. For this reason, the distances in tape direction from a functional element to the next functional element of the same type in a carrier tape according to the invention change periodically in space at a period P within production tolerances.

Typically, the periodical change, i.e. the difference between the largest distance between identical functional elements and the smallest distance between identical functional elements in a period, equals at least 5 times, in particular at least 10 times, in particular 20 times the production-related tolerance deviations of the actual positions from the nominal positions.

Preferably, the carrier tape comprises position markers that are assigned to one functional element each. The position markers can, for example, be holes or can be printed onto the carrier tape. The position markers can be used in the production process to define the positions in which functional elements are applied to the carrier tape. Moreover, the position markers be used by a device, in which a tape cassette according to the invention is inserted, to stop tape transport at a defined place in order to position a functional element precisely for a subsequent use. The distances in tape direction from position marker of a test element and the next position marker of a test element may then change periodically in space at a period of P

Further details and advantages of the invention shall be illustrated in the following based on exemplary embodiments and by referring to the appended drawings. In this context, identical and equivalent components are identified by the same reference numbers. In the figures:

5

Figure 1 shows a schematic view of an exemplary embodiment of a tape cassette;

10

Figure 2 shows a schematic view of functional elements being arranged on a carrier tape; and

Figure 3 shows another exemplary embodiment of functional elements being arranged on a carrier tape.

15 Figure 1 shows an exemplary embodiment of a tape cassette having a cassette housing 1 that contains a carrier tape 2 that carries functional elements, namely test elements 3 with detection reagents for analysis of a sample of a human or animal body fluid, as well as puncturing elements 4. The section of the carrier tape 2 carrying unused functional elements is reeled onto a reel 5. Sections of the carrier tape 2 having used functional elements are reeled onto a second reel 7. Carrier tape 2 is a film with a thickness of, for example, 0.1 mm to 0.2 mm. Test fields 3 can be of comparable thickness such that the total thickness of the configured carrier tape 2 between regions carrying functional elements 3, 4 and free regions may vary by a factor of 2 or more.

25

Carrier tape 2 can be configured with only a single type of functional elements, for example in that it carries only test elements 3 or only puncturing elements 4. Figure 2 shows an exemplary embodiment, in which carrier tape 2 carries only test elements 3 as functional elements. Moreover, it is also feasible to configure carrier tape 2 with two different types of functional elements, namely with both test elements 3 and puncturing elements 4. One exemplary embodiment of this case is shown schematically in Figure 3. As can be seen, all puncturing elements 4 are oriented in the same direction. With other words, all puncturing elements 4 point to the same edge of the carrier tape.

30

Figure 2 clearly shows that the distances in tape direction from a functional element 3 to the next functional element 3 of the same type change periodically in space at a period P. In the exemplary embodiment shown in Figure 2, a period P includes three
5 functional elements of the same type, namely three test elements 3. Figure 3 shows another exemplary embodiment, in which a period P includes four functional elements of the same type, namely four test fields 3 and four puncturing elements 4.

The length ratios are not shown to scale in Figures 2 and 3. The distances in tape
10 direction from a functional element to the next functional element of the same type can, for example, be $d_1 = 129$ mm, $d_2 = 110$ mm, and $d_3 = 108$ mm, in the exemplary embodiment shown in Figure 2. The total length of a period P then is the sum of the individual distances d_1 , d_2 , and d_3 , and equals, for example, 347 mm. The length
15 of the functional element measured in tape direction, i.e. the length of test element 3, is 10 mm in the exemplary embodiment shown in Figure 2. Accordingly, the distances change within period P by more than the length of a functional element as measured in tape direction.

The distances between consecutive functional elements of the same type in the ex-
20 emplary embodiment shown in Figure 3 are, for example, $d_1 = 114$ mm, $d_2 = 127$ mm, $d_3 = 100$ mm, and $d_4 = 98$ mm. The puncturing elements 4 in this exemplary embodiment are arranged at a constant distance with respect to the subsequent test element 3 in the direction of tape transport such that the same distances d_1 , d_2 , d_3 , and d_4 apply to the distances between consecutive puncturing elements.

25

The specified distances between neighboring functional elements include the length of the individual functional elements. Accordingly, the distance must be measured in each case between the centers of a functional element or between corresponding edges of neighboring functional elements, e.g. between a trailing edge each with re-
30 spect to the direction of tape transport or between a leading edge each in the direction of tape transport.

In both exemplary embodiments, the distances within period P change by more than 10%. The difference between the largest distance and the smallest distance is $d_1 -$

$d_3 = 129 \text{ mm} - 108 \text{ mm} = 21 \text{ mm}$ in the exemplary embodiment shown in Figure 2. This is a difference of more than 19% with respect to the smallest distance. The difference between the largest distance and the smallest distance is $d_2 - d_4 = 127 \text{ mm} - 98 \text{ mm} = 29 \text{ mm}$ in the exemplary embodiment shown in Figure 3. This is a difference of more than 29% with respect to the smallest distance from a functional element to the next functional element of said period. It is particularly advantageous in general if the difference between the largest distance and the smallest distance from a functional element to the next functional element of the same type within period P is between 10 % and 35 % with respect to the smallest distance.

10

The average distance in tape direction from a functional element to the next functional element of the same type, calculated as the arithmetic mean of all distances, within period P is $(d_1 + d_2 + d_3)/3 = 115 \text{ mm}$ in the exemplary embodiment of Figure 2. The largest distance, namely d_2 , deviates from this value by 14 mm, whereas the smallest distance, namely d_3 , deviates by only 7 mm. The deviations of the largest and the smallest distance from the average distance therefore differ by a factor of 2.

15

Accordingly, the average distance from a functional element to the next functional element of the same type is $(d_1 + d_2 + d_3 + d_4)/4 = 110 \text{ mm}$ in the exemplary embodiment that is shown schematically in Figure 3. The largest distance, namely d_2 , deviates by 27 mm from this value. The smallest distance, namely d_4 , deviates by 11 mm. The deviations of the largest and the smallest distance from the average distance therefore differ by a factor of more than 2.

20

25 In an exemplary embodiment that is not shown, the period P includes five functional elements of the same type, i.e. for example five test fields 3. Advantageous distances between consecutive test fields are, for example, $d_1=102 \text{ mm}$, $d_2=100 \text{ mm}$, $d_3=105 \text{ mm}$, $d_4=104 \text{ mm}$, and $d_5=121 \text{ mm}$.

30

For fabrication thereof, a carrier tape 2 is first provided with position markers 8 which define nominal positions of the individual functional elements. Subsequently, the functional elements are applied to the carrier tape 2 at the position markers 8. Possible deviations of the actual position of the functional elements from the nominal position defined by the position markers are negligibly small as compared to the changes

of distances within one period P . In the numerical examples provided for Figures 2 and 3, the positional uncertainty of the individual position elements is less than 1 mm. The periodical changes of the distances therefore are larger than ten-times the positional uncertainties.

5

Subsequently, the carrier tape configured with functional elements is reeled onto the reel 5 of a cassette, which may have a radius, for example, of 4 mm.

The optimal distances between functional elements of the same type depend, amongst other factors, on the thickness of the carrier tape, the height of the functional element on the carrier tape, and the radius of the reel onto which the carrier tape is reeled. Advantageous distances leading to a more even distribution of the functional elements in circumferential directions in the process of reeling can be determined by trial or by numerical simulation. In this context, the above-mentioned ratios of the distances of identical functional elements within a period P specified for exemplary purposes can be used as reference points for the determination of favorable distances in any such case.

Reference signs and numbers

	1	Cassette housing
5	2	Carrier tape
	3	Test element
	4	Puncturing element
	5	Reel
	7	Reel
10	8	Position markers
	P	Period

WE CLAIM:

1. A tape cassette having a reeled-up carrier tape that carries test elements with detection reagents for analysis of a sample of a human or animal body fluid that are arranged at a distance from each other in tape direction,
5 characterized in that the distances in tape direction from a test element to the next test element change periodically in space at a period P.
2. The tape cassette according to claim 1, wherein the distances within the
10 period P change by more than the length of one test element as measured in tape direction.
3. The tape cassette according to claims 1 or 2, wherein the distances within the period P vary at least 5%.
- 15 4. The tape cassette according to claim 3, wherein the distances within the period P vary at least 10%.
5. The tape cassette according to any one of claims 1 to 4, wherein within the
20 period P there is a difference between the largest distance and the smallest distance in tape direction from one of the test elements to the next test element of at least 5% of the smallest distance.
6. The tape cassette according to claim 5, wherein the difference between the
25 largest distance and the smallest distance in tape direction from one of the test elements to the next test element is at least 10% of the smallest distance.

7. The tape cassette according to any one of claims 1 to 6, wherein within the period P there is a difference between the largest distance and the smallest distance in tape direction from one of the test elements to the next test element of no more than 50% of the smallest distance .

5

8. The tape cassette according to claim 7, wherein the difference between the largest distance and the smallest distance in tape direction from one of the test elements to the next test element is of no more than 40%.

10 9. The tape cassette according to claim 7, wherein the difference between the largest distance and the smallest distance in tape direction from one of the test elements to the next test element is of no more than 35%.

15 10. The tape cassette according to any one of claims 1 to 9, wherein a deviation of the largest and the smallest distance, within the period P and in tape direction, from one of the test elements to the next test element, from an average distance differs by at least half, said distance being calculated as the arithmetic mean of all distances, within the period P and in tape direction, from one of the test elements to the next test element.

20

11. The tape cassette according to claim 10, wherein the deviation of the largest and the smallest distance, within the period P and in tape direction, from one of the test elements to the next test element, from an average distance differs by at least by a factor of two.

25

12. The tape cassette according to any one of claims 1 to 11, wherein the period P comprises at least three test elements.

30 13. The tape cassette according to any one of claims 1 to 12, wherein the period P comprises at most eight test elements.

14. The tape cassette according to claim 13, wherein the period P comprises at most six test elements.

5 15. The tape cassette according to claim 13, wherein the period P comprises at most five test elements.

16. The tape cassette according to any one of claims 1 to 15, wherein the carrier tape comprises at least 10 periods P.

10 17. The tape cassette according to any one of claims 1 to 16, wherein the carrier tape comprises at most 30 periods P.

18. The tape cassette according to any one of claims 1 to 17, wherein the carrier tape carries puncturing elements.

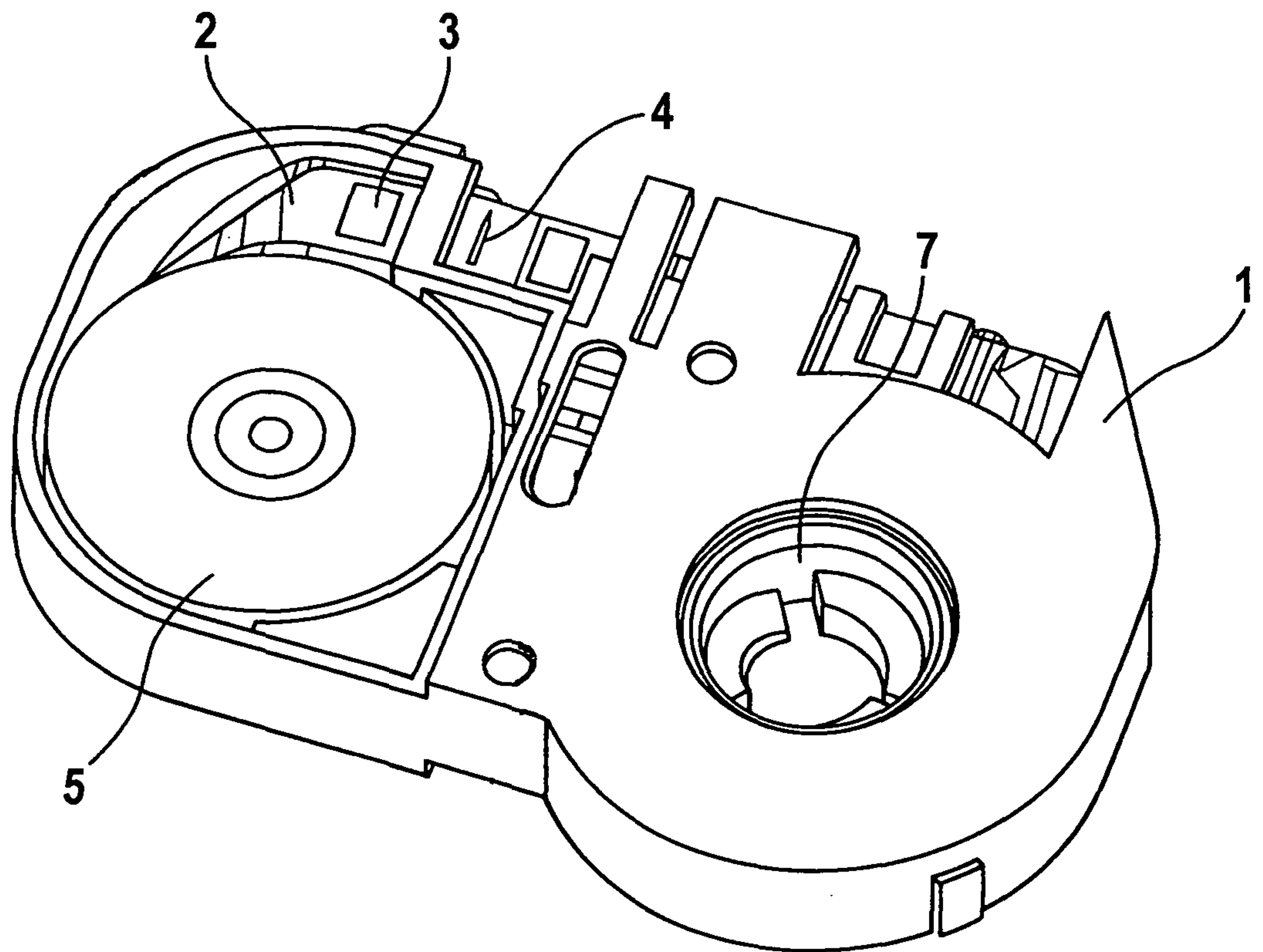
15 19. The tape cassette according to claim 18, wherein all the puncturing elements are oriented in the same direction.

20 20. The tape cassette according to claim 18 or 19, wherein the carrier tape comprises position markers at each of which one of the test elements or one of the puncturing elements is arranged.

21. The tape cassette according to claim 20, wherein the distance in tape direction between position markers changes periodically in space.

25 22. A method for manufacturing a tape cassette, whereby test elements and/or uniformly oriented puncturing elements are arranged as functional elements on a carrier tape, the carrier tape is subsequently reeled-up and introduced into a cassette housing, wherein the functional elements are arranged on the
30 carrier tape at periodically changing distances.

23. The method according to claim 22, wherein position markers are provided on the carrier tape first, and then the functional elements are arranged at positions on the carrier tape that are defined by the position markers.

**Fig. 1**

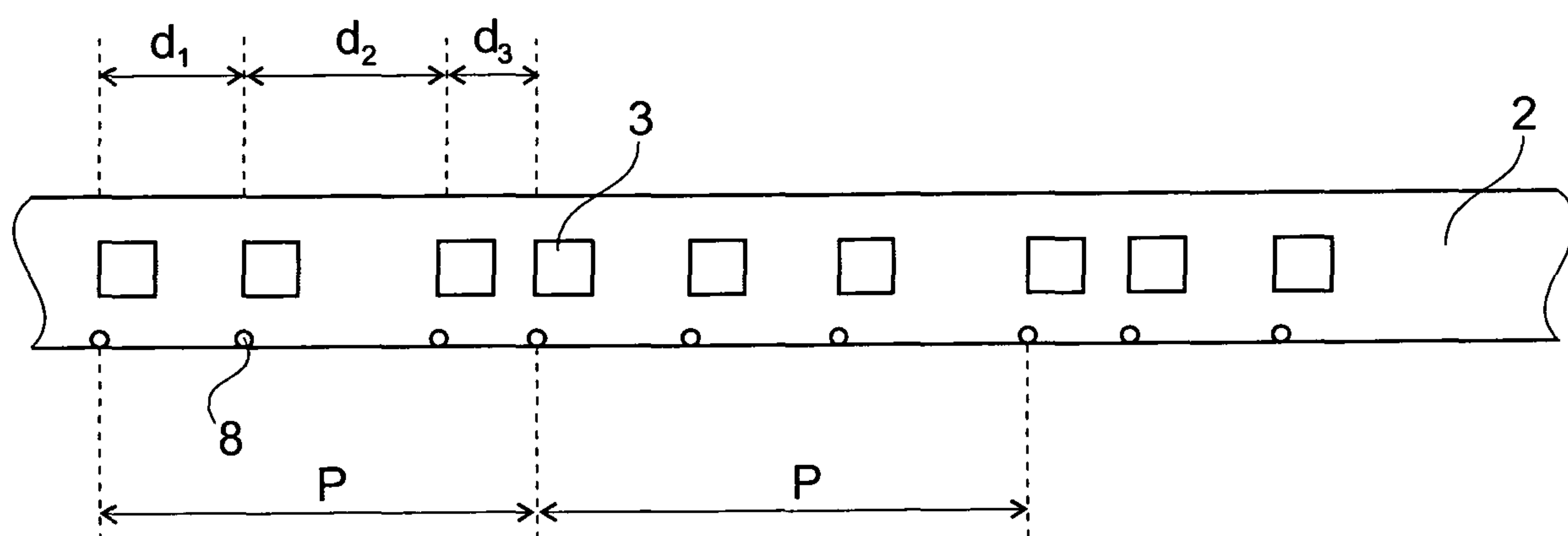


Fig. 2

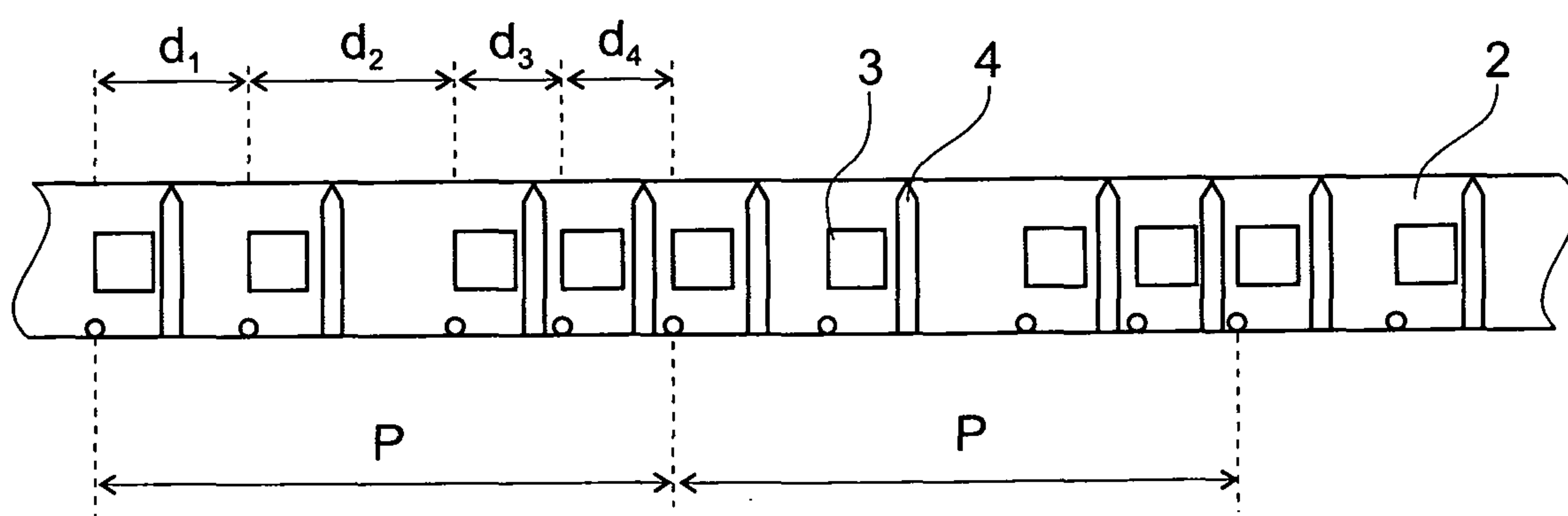


Fig. 3

