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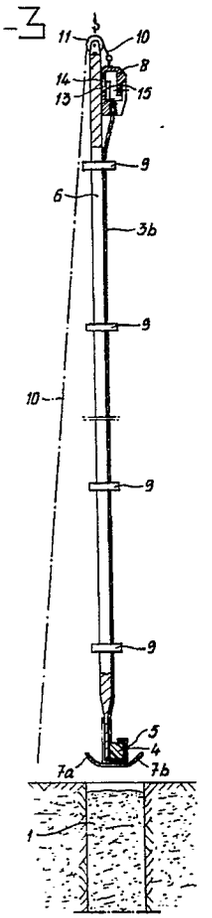
(54) Method for inserting an essentially vertical screen in the ground.

(57) For placing an essentially vertical screen in the ground a trench is dug in the ground, a mixture such as a bentonite-water mixture or a bentonite-cement-water mixture which can form an impenetrable layer is fed in to said trench, a sheeting panel is conneoted to an insertion sheet, the insertion sheet with sheeting panel is moved downwards in the mixture in such a way that a vertical locking edge of said panel and a vertical locking edge of a panel already placed in the trench are slid into each other, the connection between the insertion sheet and the sheeting panel is broken, and the insertion sheet is pulled up, so that the next sheeting panel can be connected to said insertion sheet, which actions can be repeated until a tight wall of the desired length and shape is formed from the sheeting panels in the trench. In order to avoid problems during the placing of screens of great height (for example of about 30 metres) in the ground, each sheeting panel is fixed near the top edge of an insertion sheet to said sheet, the sheeting panel is taken into a vertically downward hanging position by pulling said sheet up out of the trench and, before the combination of sheet and sheeting panel connected to it are moved downwards in the trench, this combination is moved over approximately the width of a sheeting panel in the lengthwise direction of the trench.

fig-3



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The invention relates to a method for inserting an essentially vertical screen in the ground, comprising:

- digging a trench in the ground,
- feeding a mixture into said trench, such as a bentonite-water mixture or a bentonite-cement-water mixture which can form an impenetrable layer,
- connecting a sheeting panel to an insertion sheet,
- lowering the insertion sheet with sheeting panel into the mixture in such a way that a vertical locking edge of said panel and a vertical locking edge of a panel already placed in the trench slide into each other,
- breaking the connection between the insertion sheet and the sheeting panel,
- pulling up the insertion sheet so that the next sheeting panel can be connected to said sheet, which actions can be repeated until a tight wall of the desired length and shape is formed from the sheeting panels in the trench.

Such a method is described in DE-A-3540270 and is used for the isolation of polluted ground and groundwater and for well drainage. The flexible sheeting panels are, for example, 2 - 3 metres wide. The insertion of the panels by means of an insertion sheet takes place in such a way that the locks are placed under little or no load. At the bottom side the bentonite sheeting screen must be connected to a watertight layer, for example of a natural clay or an injected synthetic layer. In particular, in the case of well drainage the screens can be of a great height, for example approximately 30 metres. Problems then occur with unrolling each panel into the vertical position from the rolled-up state and connecting one edge of the panel to the top edge of the insertion sheet.

The object of the invention is to solve these problems, and to this end the method mentioned in the preamble is characterized in that each sheeting panel is fixed at the top edge of the insertion sheet to said sheet and the sheeting panel is taken into a vertically downward hanging position by pulling said sheet up out of the trench and in that, before the combination of sheet and sheeting panel connected to it is lowered in the trench, this combination is moved over approximately the width of a sheeting panel in the lengthwise direction of the trench.

In the application of the invention the function of the insertion sheet is not only to press a panel into the ground, but also to unroll the panel from the rolled-up state into a vertical position, after which it is ready for pressing into the ground trench. In particular in the case of sheeting panels of great height (for example, about 30 metres) the method according to the invention is of great advantage.

In order to prevent the panel hanging from the insertion sheet above ground level from being beaten to and fro by the wind, when each sheeting panel is being raised above ground level by means of the insertion sheet, clips can be fixed a certain vertical distance apart on the sheet, which clips fall round the sheeting panel and protect it from the wind, and which are removed one by one when the panel is being placed in the ground.

A clamping bar fixed to the sheet can be used in order to fix a top edge of each panel to the insertion sheet.

Each sheeting panel can be pulled taut by a device being fitted between the clamping bar and the top side of the insertion sheet, by means of which a limited almost vertical displacement of the clamping bar is possible. This device can be, for example, a cable which is fixed on the clamping bar and runs over a pulley provided on the top edge of the insertion sheet to the rear side of the insertion sheet, where it is tensioned on the sheet. It is also possible for the above-mentioned device to comprise known mechanical, hydraulic or pneumatic means for making the clamping bar undergo a slight vertical displacement. It is further possible for the clamping bar to be guided additionally in the vertical direction through the fact that the clamping bar with guide pins projecting through slotted holes into the clamping bar and fixed on the insertion sheet can move freely over a certain vertical distance if the tensioning device is out of action. Other designs are also possible for tensioning the sheeting panel.

The invention also relates to an insertion sheet intended for placing sheeting panels in the ground according to the invention, in which a clamping bar is fixed near the top edge of said sheet. In order to make the above-mentioned tensioning of the sheeting panel possible, the fixing of the clamping bar can be such that a limited displacement of the clamping bar towards and away from the top edge of the sheet is possible.

Finally, the invention relates to a wind clip for connecting a sheeting panel to an insertion sheet during carrying out of the above-mentioned method, in which the clip has two flanges lying opposite each other which are intended for insertion through openings in transverse members of the insertion sheet, and in which at least one of the side parts of the clip is made slidable or hinged, and securing means are present for the purpose of securing said slidable or hinged side part.

The invention will now be explained in greater detail with reference to the figures.

Figure 1 shows a vertical section through a sheeting panel fitted in a ground trench, with an-

chor and insertion sheet projecting into it.

Figure 2 shows a vertical section of said ground trench during unrolling of the next sheeting panel.

Figure 3 shows a vertical section of the sheeting panel hanging from the top edge of the sheet above ground level and above the trench.

Figure 4 shows a top view of a ground trench with sheeting panels to be placed in the ground according to the invention.

Figure 5 shows a detail of the insertion sheet with clamping bar on a larger scale.

Figure 6 shows a cross-section of a screen with insertion sheet at the position of a wind clip.

Figures 1 to 4 illustrate the way in which the sheeting panels of a vertical ground screen are inserted in succession in a ground trench 1 filled with a bentonite-containing mixture. A sheeting panel 3 is indicated by 3a in Figure 1, and the next sheeting panel is indicated by 3b in Figures 2 and 3. Each of the panels has on the two vertical side edges a locking part, in which case a locking part 2a on a side edge of a panel can be connected, for example in the manner described in Dutch Patent Applications 8301918 or 8901423, to a locking part 2b on the other side edge of the next panel. The panels have at their bottom edge a thickened part 4 projecting into a steel anchor 5.

When a panel is being pressed into the ground use is made of a steel insertion sheet 6 which with its bottom edge also projects into the anchor 5. The anchor is provided with slanting plates 7a and 7b which centre the panel in the ground trench when it is being pressed down.

After a panel 3 (for example panel 3a) has been pressed fully into the ground trench (Figure 1), the insertion sheet 6 is pulled up.

The edge of the next panel 3b, which is in the rolled-up state, is then fixed by means of a clamping bar 8 to the top part of the insertion sheet 6, and the insertion sheet is pulled up out of the ground trench by means of a hoisting structure (not shown), during which the panel 3b unrolls. In the fully raised position of the panel 3b, as shown in Figure 3, the panel 3b hangs down along the sheet 6. If there is wind of any significance, during the raising of the sheet and unrolling of the panel, clips 9 are provided spaced apart and are fixed to the sheet and clamp the panel against the sheet. Details of the clips will be explained.

After a new anchor 5 is fitted on the bottom edge of the panel 3b and the sheet 6, the sheet 6 is first moved in the lengthwise direction of the trench over about the width of a panel, and only then is the panel 3b pushed into the ground trench by the sheet 6, it being ensured that the locking parts facing each other on the panels 3a and 3b engage with each other. The clips 9 are also removed in succession at ground level. Finally, the panel 3b assumes the position which is shown with regard to panel 3a in Figure 1, and the placing in the ground of the next panel in accordance with the cycle described above can begin. It will be clear that the wall formed from the panels can be of any desired length.

In order to be able to tension a panel and pull it flat and thereby, inter alia, to reduce the influence of the wind even further, the clamping bar 8 can be fixed in such a way to the insertion sheet 6 that the latter can undergo a limited vertical displacement, and a tensioning cable 10 can be fixed to the clamping bar 8, which cable is guided over a pulley 11 fitted on the insertion sheet 6 to a mechanical, hydraulic or pneumatic cable tensioning device of known design (not shown). Tensioning the cable 10 pulls the panel taut. Another possibility for pulling the panel 3 taut is to connect the clamping bar 8 directly to the top side of the insertion sheet by means of other mechanical and/or hydraulic or pneumatic devices which can impose limited virtually vertical movements on the clamping bar 8.

The clamping bar 8 has two clamping jaws 8a, 8b between which the top edge of a panel 3 can be clamped. The clamping jaws 8a, 8b can be operated by mechanical, hydraulic or pneumatic devices. In order to give the bar its limited vertical displacement possibilities relative to the insertion sheet, two or more pins 13 projecting through the vertical slotted holes 14 into the clamping bar are welded to the sheet. Heads 15 welded to the pins 13 prevent the pins from coming out of the slotted holes.

An embodiment of the insertion sheet 6 with a wind clip 9 is shown in Figure 6. The U-shaped clip has two flanges 16a, 16b which lie opposite each other and project through openings in transverse plates 17a, 17b of the insertion sheet 6. In this case parts 17a, 17b, 17c and 17d are components of the reinforcement structure 17 of insertion sheet 6. At the position of the corner pieces the sheet 6 has semi-cylindrical vertical rods 18a, 18b which are fitted on it and can engage on a panel 3 and clamp it against spacers 19a, 19b welded on the wind clip 9 concerned.

One of the side parts of the clip 9 is hinged by means of a rotary pin 20 and can be secured in the position shown by means of a removable securing pin 21. When the securing pin is removed the end part can be turned away to the position shown by dotted and dashed lines in Figure 6, and the side part of the clip can be pivoted into a position in which the flange 16b projects through an opening of the transverse plate 17b.

For the idea of the invention it is essential that a sheeting panel 3 can be taken by the insertion sheet 6 into a vertical position above ground level

and that sheeting panel 3 can subsequently be pulled taut, following which insertion sheet 6 places this sheeting panel next to the previous panel 3 after being slid along over a panel width in the lengthwise direction of the trench.

Claims

1. Method for placing an essentially vertical screen in the ground comprising:
   - digging a trench in the ground,
   - feeding a mixture into said trench, such as a bentonite-water mixture or a bentonite-cement-water mixture which can form an impenetrable layer,
   - connecting a sheeting panel to an insertion sheet,
   - lowering the insertion sheet with sheeting panel into the mixture in such a way that a vertical locking edge of said panel and a vertical locking edge of a panel already placed in the trench slide into each other,
   - breaking the connection between the insertion sheet and the sheeting panel,
   - pulling up the insertion sheet so that the next sheeting panel can be connected to said sheet,

   which actions can be repeated until a tight sheeting wall of the desired length and shape is formed from the sheeting panels in the trench,
   characterized in that
   each sheeting panel is fixed near the top edge of the insertion sheet to said panel and the sheeting panel is taken into a vertically downward hanging position by pulling said sheet up out of the trench and in that, before the combination of sheet and sheeting panel connected to it is lowered in the trench, this combination is moved over approximately the width of a sheeting panel in the lengthwise direction.

2. Method according to Claim 1, characterized in that, when each sheeting panel is being raised above ground level by means of the insertion sheet, clips are fixed a vertical distance apart on the sheet, which clips fall round the sheeting panel in order to protect it from the wind, and which clips are removed one by one when the panel is being placed in the ground.

3. Method according to Claim 1 or 2, characterized in that a clamping bar fixed to the sheet is used for fixing an edge of each sheeting panel to the insertion sheet.

4. Method according to Claim 3, characterized in that pins projecting through vertical slotted holes in the sheet or the clamping bar extend between the clamping bar and the insertion sheet and permit a limited vertical displacement of the clamping bar relative to the insertion sheet, and in that the clamping bar is pulled upwards over a limited distance by a cable running over a pulley provided on the top edge of the sheet for pulling the sheeting panel in question taut.

5. Insertion sheet (6) intended for placing in the ground a sheeting panel according to the method of Claim 3, characterized in that at the top edge of the sheet a clamping bar (8) is fixed in such a way that a limited displacement of the clamping bar towards and away from the top edge of the partition is possible.

6. Insertion sheet according to Claim 5, characterized in that the limited displacement of the clamping bar is produced by known mechanical and/or hydraulic and/or pneumatic devices.

7. Insertion sheet according to Claim 5 or 6, characterized in that a pulley (11) is provided on the top edge of the insertion sheet for guiding a tensioning cable (10) fixed on the clamping bar.

8. Wind clip (9) for connecting a sheeting panel to an insertion sheet when carrying out the method according to Claim 2, characterized in that the clip has two flanges (16a, 16b) lying opposite each other which are intended for insertion through openings in transverse members (17a, 17b) of the insertion sheet, and in that at least one of the side parts of the clip is made slidable or (at 20) hinged, while securing means (21) are present for the purpose of securing said slidable or hinged side part.

fig-1

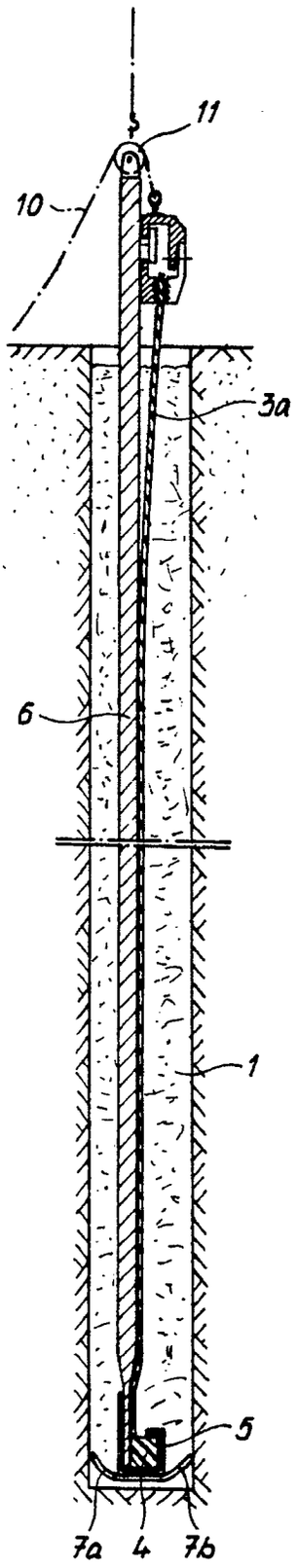


fig-2

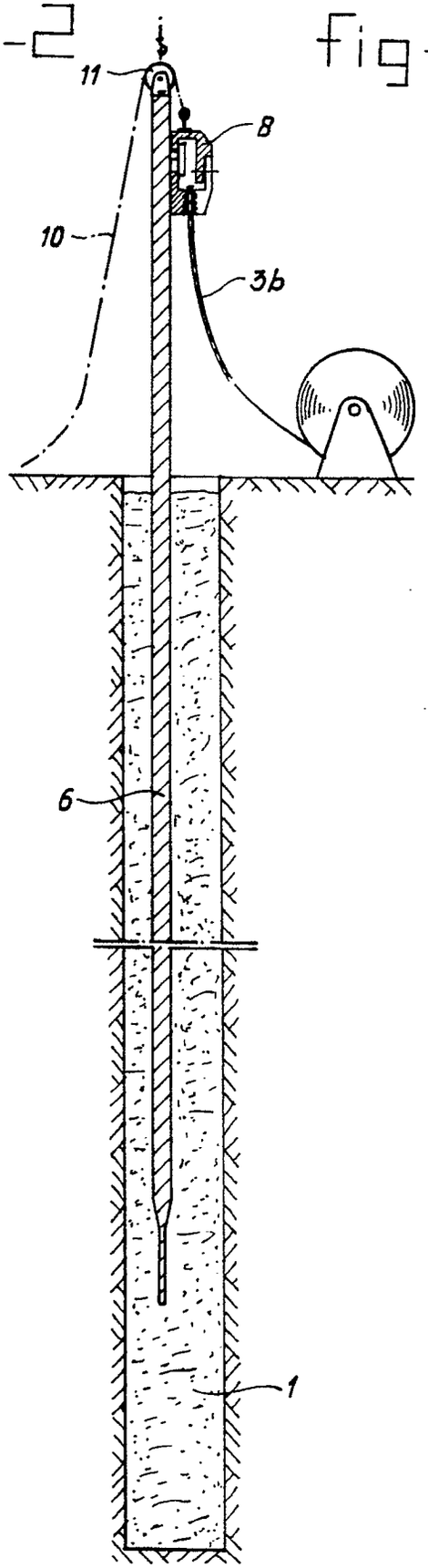
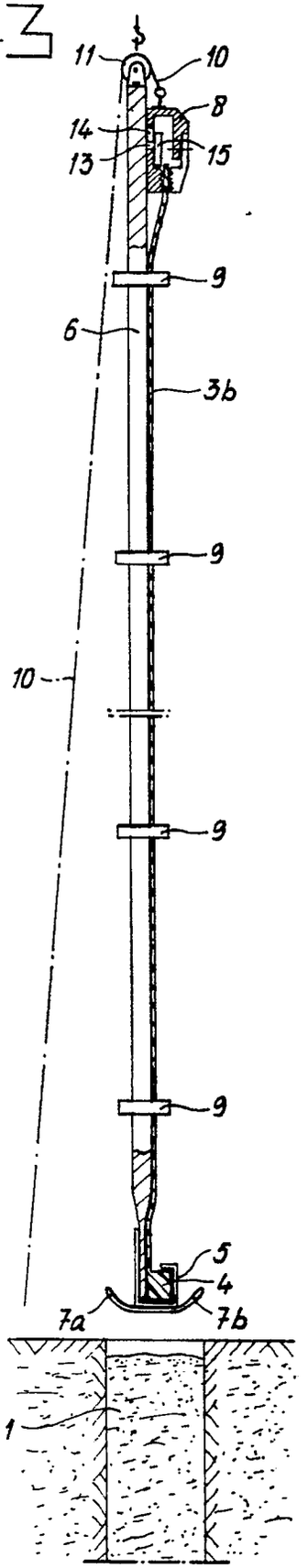


fig-3



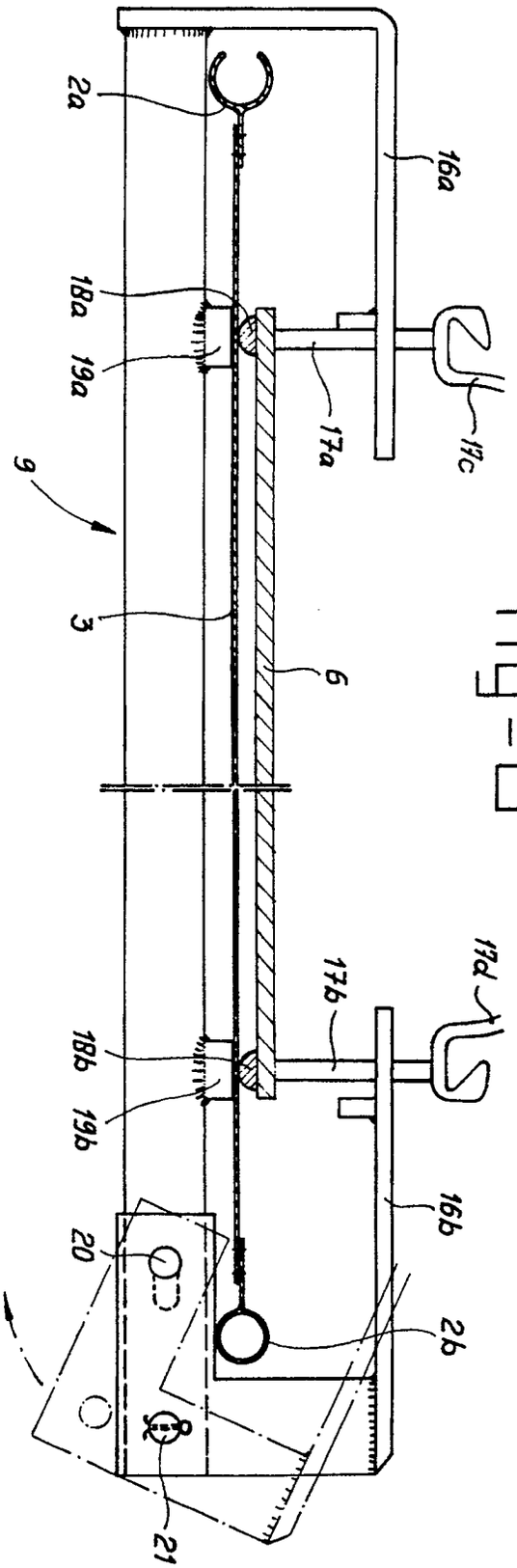


fig-6

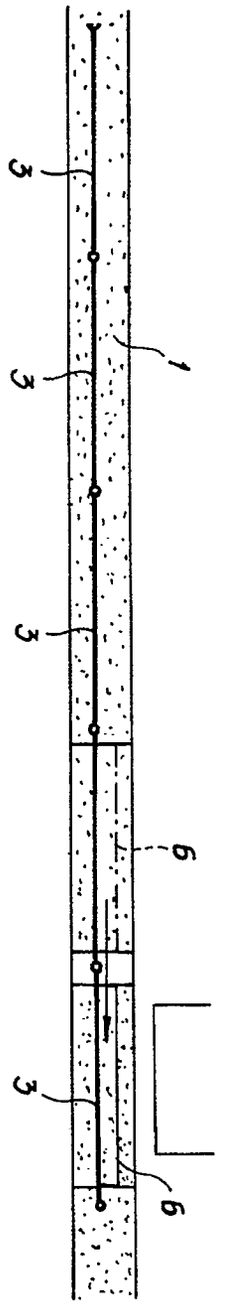


fig-4

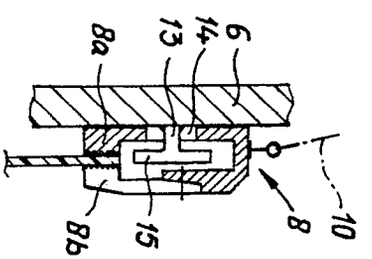


fig-5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 20 0886

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X,Y	BE-A-6 271 42 (GEMEENTE ROTTERDAM) * page 2, line 1 - page 3, line 27 * * page 4, line 3 - line 32 * * figures 1,2 *	5,1-3	E 02 D 19/18
D,Y	DE-A-3 540 270 (WAYSS & FREYTAG) * column 5, line 64 - column 6, line 21 * * column 6, line 68 - column 7, line 22 @ figures 4,10,11 *	1-3	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			E 02 D

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	15 July 91	KERGUENO J.P.D.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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