(19) DANMARK

(10) DK/EP 2923015 T3

(12) Oversættelse af europæisk patentskrift

Patent- og Varemærkestyrelsen

(51) Int.Cl.: *E 04 H 5/04 (2006.01)* *H 02 B 7/06 (2006.01)*

(45) Oversættelsen bekendtgjort den: **2019-04-15**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2019-01-09**

(86) Europæisk ansøgning nr.: **13792680.4**

(86) Europæisk indleveringsdag: **2013-11-19**

(87) Den europæiske ansøgnings publiceringsdag: **2015-09-30**

(86) International ansøgning nr.: **EP2013074126**

(87) Internationalt publikationsnr.: **WO2014079824**

(30) Prioritet: **2012-11-23 DE 102012221498**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(73) Patenthaver: **Wobben Properties GmbH, Borsigstrasse 26, 26607 Aurich, Tyskland**

(72) Opfinder: **VAN DYK, Holger, Poststrasse 17, 26632 Ihlow, Tyskland**
**FLESSNER, Heinz, Moorweg 55, 26632 Ihlow, Tyskland**

(74) Fuldmægtig i Danmark: **Zacco Denmark A/S, Arne Jacobsens Allé 15, 2300 København S, Danmark**

(54) Benævnelse: **OVERFØRSELSSTATION TIL INDFØRING AF ELEKTRISK ENERGI SAMT VINDENERGIANLÆGSPARK MED EN SÅDAN OVERFØRSELSSTATION**

(56) Fremdragne publikationer:
**DE-A1- 2 626 186**
**DE-A1- 10 009 013**

The present invention relates to a transmission station for feeding locally provided electrical energy, in particular provided by one or more wind power installations, into a grid. The invention further relates to a wind farm comprising one or more such transmission stations.

Wind power installations are increasingly used to provide electrical energy. The rotational movement of the rotors that is produced by wind power is transformed to AC voltage by means of generators, and is then discharged from the wind power installation and ultimately fed into a public utilities network, hereinafter also referred to as grid. For feed-in purposes, the voltage produced by the wind power installation is brought to the required form by means of various controls. This mostly requires the use of inverters and/or rectifiers and of one or more transformers. These intermediate steps are taken either at the wind power installation itself or at corresponding control installations that are external to the wind power installation. If controls that are external to the wind power installation as well as further infrastructure for feed-in purposes should be required, such required controls are accommodated in housings to, on the one hand, offer protection from external influences and, on the other, to protect the environment from damages caused by voltage. Housings that accommodate the connection to the grid are referred to as transmission stations in the industry.

In such transmission stations, control units are provided for to ensure that the voltage delivered to a transmission station is provided such that it can be fed into the grid via a line connection that belongs to the grid. Whether or not this requires voltage direction and/or transformation inside the transmission station depends on the wind power installations used from time to time and possibly on interconnected further stations.

Because of the high voltages and/or currents present at such transmission stations that occasionally collect the electrical energy provided by several wind power installations and process it for feed-in purposes, there is a risk of short-circuits in the control units. In extreme cases, this may lead to the formation of electric arcs inside the control units, which then lead to a gas explosion inside the transmission station that is accompanied by the propagation of a blast wave and heavy smoke formation. This is a major health risk especially for those who are present at the transmission station at the time of formation of an electric arc.

Various arrangements are described in prior art, whose goal it is to remove as quickly as possible the smoke that has formed at such places inside a transmission station, where people might be located. DE 100 09 013 A1 concerns a transportable room cell in the form of a walk-in transformer station partially lowered into the ground and containing a transformer room as well as rooms for voltage installations. It has front and side walls and at

least one roof panel mounted thereon, wherein a recess for a fan door or a comparable door-like closing element of the transformer room is provided in at least one of the walls. Furthermore, DE 26 26 186 A1 concerns a building for an electrical transformer or switching station with a potential explosive medium-voltage switchgear, in which a control room is provided in front of the switchgear and the switchgear has a side which is adapted for the exit of an explosion. In addition, pressure relief openings are provided which are preferably arranged higher than the height of the switchgear, wherein a propagation space connecting the explosion outlet side with the pressure relief openings is provided. However, general plant safety still needs to be improved at such transmission stations.

Given the ever increasing sale of wind power installations and an increasingly local organization of power generation because of the growing share of regenerative energy, there is, in particular, an additional duty to ensure the improvement of safety at transmission stations in an economically efficient manner.

The object of the invention was thus to provide a transmission station that offers better protection for people against the effects of electric arcs inside a transmission station in an economically efficient way.

The invention solves the underlying problem according to the present invention by providing a transmission station pursuant to Claim 1. The invention solves this problem, in particular, for a transmission station of the type mentioned at the beginning, which features a line connection belonging to the grid, a control unit that is configured to regulate feed-in, in particular to transform the locally provided electrical energy and feed-in by means of the line connection belonging to the grid, and a - preferably weather-proof and lockable - housing, within which the line connections, fasteners and control unit are arranged, with such housing featuring a first, accessible room and a second room that is connected to the outside world by means of an exhaust pipe, with such first and second room being connected to each other by means of a joint recess, with such control unit closing the joint recess, and with one casing of the control unit being open in the area where the recess is closed and/or showing a predetermined breaking point that is adapted to fail if an electric arc occurs inside the control unit, wherein the exhaust pipe extends from the second room into the first room through a lead-through opening and across the first room, and leaves the first room through a side or ceiling wall of the housing, and wherein the exhaust pipe is inserted through the lead-through opening by means of a divisible flange.

Here, the invention takes advantage of the realization that protection of the persons located inside the transmission station from exposure to the blast wave and smoke formation is

best when the area where persons may be located is exposed as little as possible to such a blast wave and, especially, to the smoke that will form. Instead of trying to discharge the blast wave and smoke from the area where persons are located as quickly as possible, the invention pursues the approach of preventing the blast wave from spreading and smoke from forming in the room where persons may be located, if possible. The proposed solution thus provides to place the control unit in the transmission station in the above-described manner above a through-hole leading to a second room, with the control unit being designed such that the electric arc forming inside the control unit and the accompanying blast wave will follow the path of least resistance and spread through the joint recess and into the second room, where no persons are located. Since such second room is connected to an exhaust pipe, the blast wave and smoke that has formed can be discharged from the housing through such exhaust pipe. Compared to already known solutions, this will clearly reduce the exposure to smoke and pressure for persons possibly located in the first room.

Because the exhaust pipe is laid completely within the housing all the way to the point where it leaves the housing, it is better protected from external influences. This also allows for checking on the condition of the seal faces inside the transmission station. Another advantage is that the outside dimensions of the transmission station are not raised any further by add-on parts, such as externally laid exhaust pipes. The flange shows two halves, each one comprising half of the exhaust pipe. Designing a flange as a divisible flange has the advantage that it is more easily detachable from the exhaust pipe, for example in case of maintenance or if the exhaust pipe needs to be replaced. Another advantage of a flange that can be replaced in such a manner is that the housing of the transmission station can be designed uniformly. The same floor slabs, which separate the first room from the second room, can be used for switchboards of any size. Depending on the size of the control installations, the exhaust pipe, which runs across the first room as a down pipe, must have different diameters. However, by selecting an adequate - preferably divisible - flange, one can use exhaust pipes with different diameters for the same floor slab by accordingly adapting the flange to the exhaust pipe, on the one hand, and to the size of the lead-through opening, on the other.

Preferably, the exhaust pipe according to the invention features a down pipe that is actively connected to a backlash element, with such backlash element being configured to release the down pipe in case of overpressure in the second room. Here, overpressure means the adjacent air pressure outside the housing in the second room that is relative to the ambient pressure.

Preferably, the backlash element can be moved back and forth between a locked position and a released position. Further preferably, the backlash element is in a normally closed position (NC) - the so-called locked position - and can be moved from locked to released position by means of the overpressure in the second room, once a critical pressure value has been reached, and automatically back to the locked position due to the force of gravity and/or by means of a return means, once the pressure falls below a critical value. If an additional return means is to be provided for in support of gravity and to increase the critical pressure value, as of which triggering takes place, it is preferred to design such return means as a pull-spring.

According to a particularly preferred embodiment of the invention, the second room is arranged underneath the first room, from which it is separated by a joint wall. Here, wall means a floor or ceiling element, such as a joint floor or ceiling panel. According to this embodiment, it is particularly preferable that one does not have to abandon already established room layout concepts. Preferably, the connection line belonging to the grid is laid in the "basement" of the transmission station, i.e. into the second room. When the transmission station is installed and recessed in the ground, at least parts of the second room are preferably in the ground as well. According to the invention, the otherwise unused cavity underneath the first room in the transmission station now has the additional function of serving as an extension of the exhaust pipe.

According to a second aspect, the invention relates to a wind farm according to Claim 6. For this wind farm having one or more wind power installations for the provision of electrical energy and one or more transmission stations that are connected to the one or more wind power installations by means of electrical lines, the invention solves its underlying task such that the one or at least one of the several transmission stations is designed according to one of Claims 1 through 5.

The invention is described in more detail below based on preferred embodiments, with reference to the attached figures. The figures show the following:

Figure 1 shows the schematic spatial illustration of a transmission station according to a preferred exemplary embodiment, and

Figure 2 shows a schematic cross-section of the transmission station according to Figure 1.

Figure 1 shows a transmission station 1 according to a preferred exemplary embodiment of the invention. Figure 2 shows a schematic cross-section of such a transmission station. Transmission station 1 shows a housing 3, which features a base-plate area 4 that is to be embedded in the ground and a superstructure 6 that is to remain above ground. A lockable door 9 is provided for in superstructure 6. A plurality of cable ducts 12, 14 and 16 are provided for in base-plate area 4. Cable ducts 12, 14, 16 serve preferably as cable inlets. A grounding point 13 is arranged in yet another area of base-plate 4, in a corner area of Figure 1. The transmission station features attachment points 18 at each of its four corners, which are arranged in pairs on the opposite side and serve to apply lifting gear. Two of these attachment points are shown in Figure 1. They are not shown in Figure 2 for reasons of clarity.

A control unit 7, which is shown exemplary as a switch cabinet, is arranged inside transmission station 1. Preferably, control unit 7 features a casing 10 and therein one or more switchboards and/or measuring fields. It is arranged on a floor slab 8. A first recess 13 is provided for in floor slab 8, which separates a first room 5 from a second room 11. Control unit 7 is arranged on, and directly conterminous to, recess 13. The second room 11 is separated from the first room 5 by closing recess 13 by means of control unit 7.

In addition, floor slab 8 features a lead-through opening 15. A down pipe 17 is inserted in lead-through opening 15, which extends through lead-through opening 15 and downwards into the second room 11 and is led out of the first room 5 through a ceiling wall 22. An alternative preferred embodiment provides for the down pipe to be led out through a side wall. The exhaust pipe, which is formed by down pipe 17, is attached to floor slab 8 of transmission station 1 by means of a flange 21. Flange 21 is set in concrete in floor slab 8 and is designed preferably as a steel flange. Preferably, down pipe 17 features a correspondingly designed collar for optimum fastening to flange 21, which collar can be coupled to flange 21 with common flange coupling means. A backlash element 19 is arranged as a flap at an upper end of down pipe 17 in Figure 2. The flap is kept in the depicted closed position thanks to the force of gravity, optionally also supported by one or more return elements, such as springs. In this position, the exhaust pipe is closed and blocked.

Transmission station 1 according to Figure 2 is embedded in the surrounding ground 101, so that the connection cables belonging to the grid can be laid directly into second room 11, while the first room 5 remains accessible from the outside through door 9.

If an electric arc develops, for example as a result of switching defects, it will spread from the control unit - its point of origin - towards the path of least resistance. As the walls of

casing 10 of control unit 7 are designed to provide sufficient stability in such incidents, the electric arc and the developing blast wave (due to gas ignition) will spread downwards, since control unit 7 is essentially open at the bottom - as indicated by the dashed line - or, respectively, has a predetermined failure point, which will give way if the pressure should rise within control unit 7. In the event of such an incident, the electric arc and blast wave and the smoke that develops at the same time will initially spread downwards in the direction of arrow 50. The first room 5 will remain mostly unaffected by the blast wave and, in particular, by the developing smoke, apart from minor amounts of smoke that will enter the first room 5 through potentially leaky spots in control unit 7. Such smoke will be pushed into the second room 11 and will then spread through the exhaust pipe, in particular through down pipe 17, and in the direction of arrow 52. If a specific, predictable pressure threshold is exceeded, flap 19 will release the exhaust pipe, and both smoke and overpressure will leave housing 3 and discharge into the environment outside. After release from the locked position, as shown in Figure 2, towards a released position, the pressure inside transmission station 1 will drop quickly below the critical threshold, which will make flap 19 return to its original locked position. This will mostly protect the inside of transmission station 1 from external influences. At the same time, most of the dangerous smoke will be released.

With the above-described embodiment, the invention provides a means for improving plant safety. Room 5 inside the transmission station 1 becomes a safer place because of the targeted discharge of the electric arc into the second room 11. Because the first room 5 can be considered essentially blast wave free even in the event of an incident after it has been ensured that the fault arc is discharged, the exposure due to an electric arc, which puts at risk especially those who are located inside of first room 5, is reduced significantly.

## Patentkrav

**1.** Overførselsstation (1) til indføring af lokalt tilvejebragt elektrisk energi, især tilvejebragt af et vindenergianlæg, i et strømnet, med
- en ledningstilslutning på strømnetsiden,
- en styreenhed (7), som er indrettet til regulering af netindføringen, især til omdannelse af den lokalt tilvejebragte elektriske energi og netindføringen ved hjælp af ledningstilslutningen på strømnetsiden, og
- et fortrinsvis vejrfast og aflåseligt hus (3), hvori ledningstilslutningerne, forbindelsesmidlerne og styreenheden (7) er anbragt, hvor
- huset (3) har et første rum (5), der kan betrædes, og et andet rum (11), som er forbundet med de ydre omgivelser ved hjælp af en afgangsluftledning,
- det første rum (5) og det andet rum (11) er forbundet med hinanden ved hjælp af en fælles udsparing,
- styreenheden (7) lukker den fælles udsparing (13), og

hvor et hus (10) af styreenheden (7) er åbent i området, hvor udsparingen (13) er lukket, og/eller har et forudbestemt brudsted, som er tilpasset til at svigte, når der opstår en lysbue inde i styreenheden (7),
**kendetegnet ved, at** afgangsluftledningen strækker sig fra det andet rum (11) gennem en gennemføringsåbning (15) ind i det første rum (5) og gennem det første rum (5) og fra en side- eller loftsvæg af huset (3) er ført ud af det første rum (5), og
hvor afgangsluftledningen ved hjælp af en delbar flange (21) er ført gennem gennemføringsåbningen (15).

**2.** Overførselsstation (1) ifølge krav 1,
hvor afgangsluftledningen har et faldrør (17) med et tilbageslagselement (19), hvor tilbageslagselementet (19) er indrettet til at frigive faldrøret (17) ved overtryk i det andet rum (11).

**3.** Overførselsstation (1) ifølge krav 2,
hvor tilbageslagselementet (19) kan bevæges frem og tilbage mellem en spærreposition og en frigivelsesposition.

**4.** Overførselsstation (1) ifølge krav 2 eller 3,
hvor tilbageslagselementet (19) ved hjælp af et overtryk, der findes i det andet rum (11), når der nås en kritisk trykværdi, kan bevæges fra spærrepositionen til frigivelsespositionen, og ved underskridelse af den kritiske trykværdi ved hjælp af tyngdekraften og/eller ved hjælp af tilbagestillingsmidlet vender automatisk tilbage til spærrepositionen.

**5.** Overførselsstation (1) ifølge et af kravene 2 til 4,
hvor det andet rum (11) er anbragt under det første rum (5) og er adskilt fra dette ved en fælles væg (8).

**6.** Vindenergianlægspark med
- et eller flere vindenergianlæg til tilvejebringelse af elektrisk energi og
- en eller flere overførselsstationer, som ved hjælp af elektriske ledninger er forbundet med det ene eller de flere vindenergianlæg, hvor den ene eller mindst en af de flere overførselsstationer (1) er udformet ifølge et af kravene 1 til 5.

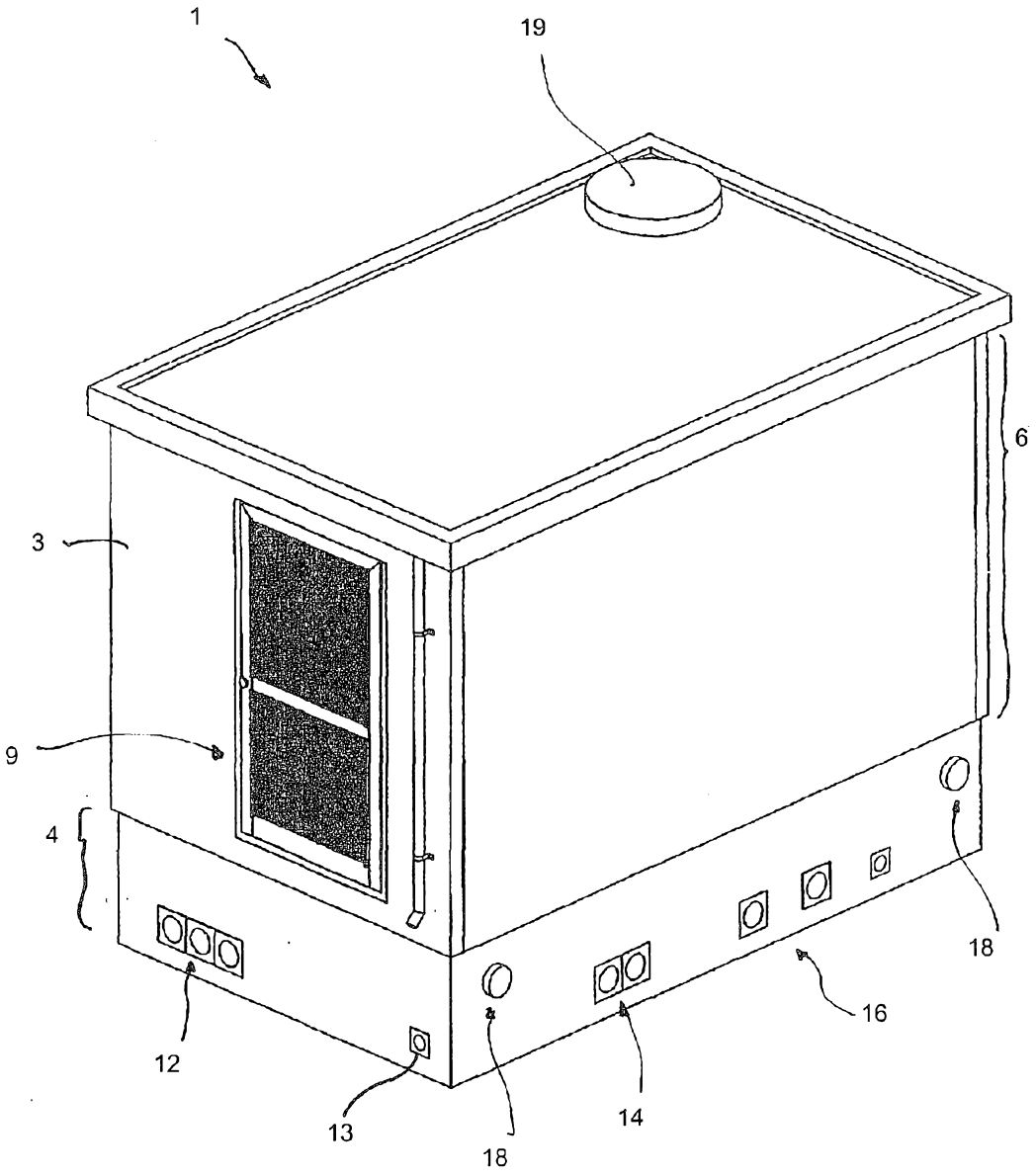


Fig. 1

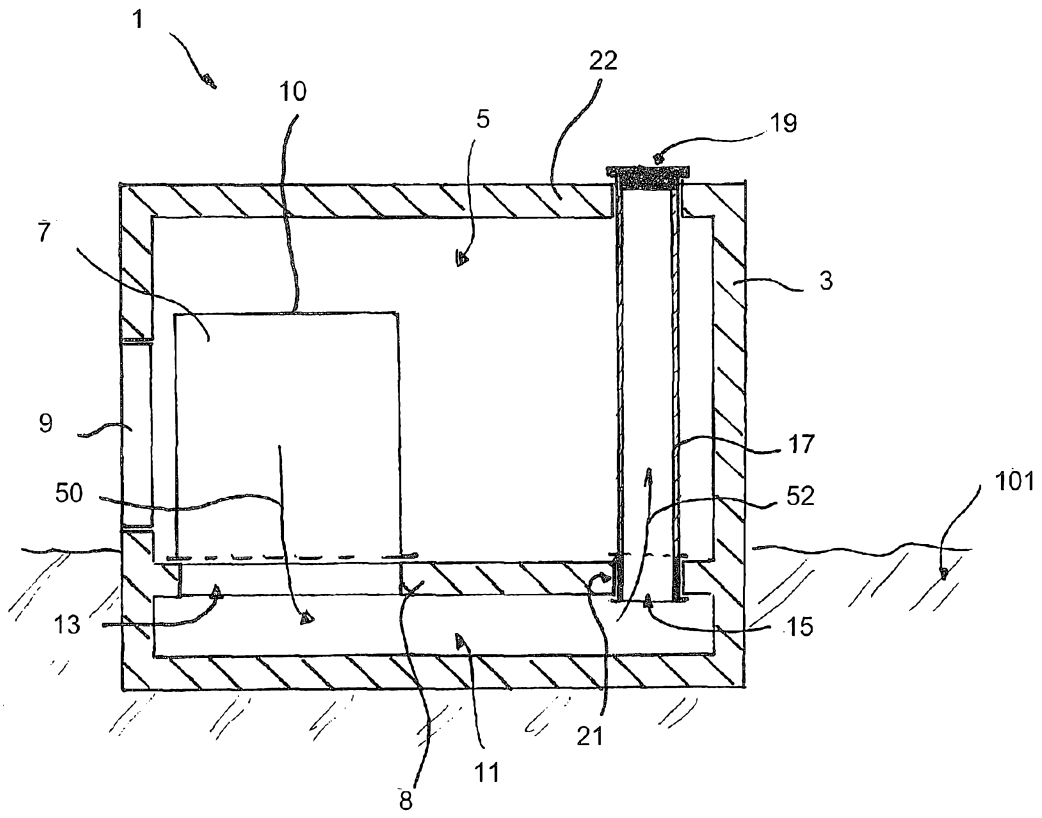


Fig. 2