



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.09.2013 Bulletin 2013/37

(51) Int Cl.:
H01H 9/00 (2006.01) **H01H 3/44 (2006.01)**

(21) Application number: **12158241.5**

(22) Date of filing: **06.03.2012**

(84) Designated Contracting States:
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
Designated Extension States:
BA ME

- **Tossavainen, Katriina**
SE-784 43 Borlänge (SE)
- **Hagberg, Håkan**
SE- 726 31 Skultuna (SE)

(71) Applicant: **ABB Technology Ltd**
8050 Zürich (CH)

(74) Representative: **Ahrengart, Kenneth**
ABB AB
Intellectual Property
Ingenjör Bååths Gata 11, T2 Floor E
721 83 Västerås (SE)

(72) Inventors:
• **Gustavsson, Niklas**
SE-771 34 Ludvika (SE)

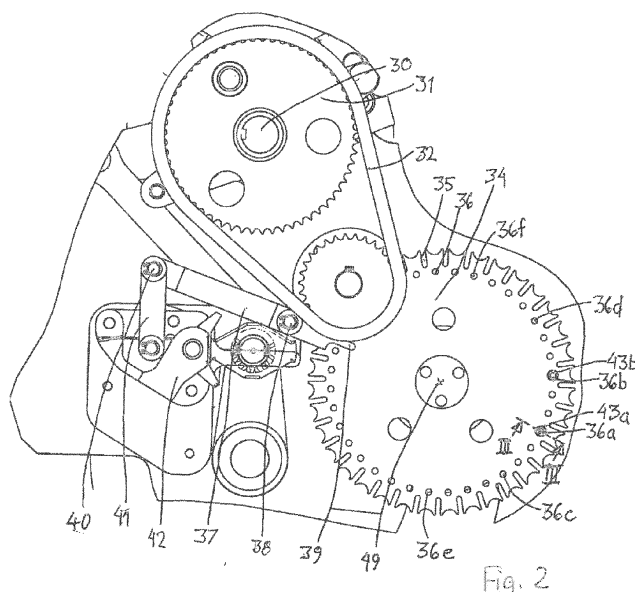
(54) **A tap changer and a method related thereto**

(57) The invention relates to a tap changer with a diverter switch and a tap selector. The tap selector has a plurality of fixed contacts and a pair of fine selector arms with a movable contact for selective engagement with any one of the fixed contacts. The tap changer includes an end location stop device having a locking link (37) and a rotatable wheel (34). The wheel (34) is arranged to turn a certain angle when the fine selector arm moves from one fixed contact to an adjacent fixed contact. On one side, the wheel (34) is provided with a first

end stop unit (43a) arranged to abut the locking link (37) when the fine selector arm moves beyond a first end contact of the fixed contacts. The locking link (37) is arranged to lock drive of the diverter switch when the first end stop unit (43a) abuts the locking link (37).

According to the invention, the wheel (34) includes a plurality of mounting means (36) at different angular positions for the first end stop unit (43a).

The invention also relates to a method for arranging an end stop limitation device on such a tap changer.



Description

Field of invention

[0001] The present invention in a first aspect relates to a tap changer including a diverter switch and a tap selector, which tap selector has a plurality of fixed contacts and a pair of fine selector arms with a movable contact for selective engagement with any one of the fixed contacts, which tap changer includes an end location stop device having a locking link and a rotatable wheel, which wheel is arranged to turn a certain angle when the fine selector arm moves from one fixed contact to an adjacent fixed contact, and which wheel on one side thereof is provided with a first end stop unit arranged to abut the locking link when the fine selector arm moves beyond a first end contact of the fixed contacts, whereby the locking link is arranged to lock drive of the diverter switch when the first end stop unit abuts the locking link.

[0002] In a second aspect the invention relates to a method for arranging an end location stop of a tap changer of the above described type.

Background of the invention

[0003] A tap changer is commonly used in connection with a transformer in order to vary the transformation rate thereof. In a transformer with a tap changer one of the windings in the transformer has a fixed amount of turns connected to the circuit. The other winding has one fixed connection point, whereas the other connection point can be selected among a number of fixed contacts to attain a required voltage. The selectable fixed contacts may be located after each other along a portion of the winding corresponding to 70% to 100% of its full extension.

[0004] Upon a change in the load connected to the transformer or due to other influences it might be required to change the connection point. The need of changing the tap point is often triggered automatically in response to sensed parameters. Tap changing includes a plurality of manoeuvres including the opening and closing of switches e.g. via a spring loaded energy accumulator and moving a fine selector arm to a new fixed contact. These manoeuvres have to be performed in a certain sequence and in a certain time relation.

[0005] A tap changing manoeuvre includes the change of connection from one connection point to an adjacent connection point. This is performed by a fine selector arm establishing the contact with the respective fixed contact.

[0006] In the row of fixed contacts there is a first and second end contact at the respective end of the row. When the fine selector arm is connected to one of the end contacts it might at certain circumstances be a risk that an actuating order is given to move beyond the end contact, with damage to the tap changer as a consequence. This can occur in case of faulty mounting of the device or wrong matching between the tap selector and the diverter switch, which components in many cases are

separately delivered. In order to avoid this, it is known to provide the tap selector with an end location stop preventing manoeuvring operation beyond the end contacts. Such end location stops usually are realized in that a wheel, e.g. of the Geneva type is actuating the fine selector arm, whereby the wheel turns a certain angle for each movement of the fine selector arm from one fixed contact to the adjacent. The end location stop on such a wheel can include a pair of stop units mounted on the wheel and arranged to limit the rotation of the wheel to be less than 360 degrees.

[0007] Illustrative examples of end location stops are disclosed in US5165295, US6060669 and US7750257.

[0008] The number of fixed contacts in a tap changers vary between different models and sizes. Typically the number of fixed contacts is in the range of 5 to 35, whereby those tap changers having a large number of fixed contacts usually also has a pre-selection. This means that the end location stop has different design for different numbers of fixed contacts. The need to have different designs in this respect for different tap changers in a model range results in circumstantial manufacturing.

[0009] A tap changer is driven by a manoeuvring device that is mechanically connected to the tap changer for the drive of its actuation. It is usual that also the manoeuvring device has an end setting limitation for safety reasons. Since one and the same manoeuvring device can be connected to different types or sizes of tap changers it is common that the end setting limitation of the manoeuvring device is arranged such that it can be connected to tap changers having different numbers of fixed contacts.

[0010] A typical example of such an end setting limitation is disclosed in US2011/005816. This end stop setting limitation has an indicator wheel with two trigger pins limiting the angular movement of the indicator wheel in that the trigger pins hits a trigger plate at the end positions. The angular position of the trigger pins can be selected by inserting the trigger pins in selected holes in the indicator wheel.

[0011] The thus achieved flexibility of the manoeuvring device to adapt to different tap changers, however, does not solve the need of various designs of the end location stop of the tap changer for different number of fixed contacts.

Summary of invention

[0012] The object of the present invention is to overcome the above mentioned drawback related to the end location stop in a tap changer, and thus to attain a tap changer where its end location stop easily can be adapted to a varying number of fixed contacts.

[0013] This object is according to the invention achieved in that a tap changer of the kind specified in the introduction of this description includes the specific features that the wheel of the end location stop includes a plurality of mounting means at different angular positions

for the first end stop unit.

[0014] The first end stop unit prevents switching when the fine selector arm receives a command to move beyond the first end contact of the fixed contacts. Since the angular mounting position of the end stop unit can be selected by selecting any of the mounting means in the wheel, the same end location stop can be used in tap changers of different numbers of fixed contacts. This reduces the manufacturing and assembling costs. Few articles are required, and it is possible to assembly late in the product structure as well as in the manufacturing process. Since the assembly time and number of articles in storage are reduced, the production costs will be lower.

[0015] According to a preferred embodiment of the invented tap changer, the wheel is provided with a second end stop unit arranged to abut the locking link when the fine selector arm moves beyond a second end contact of the fixed contacts, whereby the locking link is arranged to lock drive of the diverter switch when the second end stop unit abuts the locking link.

[0016] With this embodiment actuation beyond also the second end contact of the fixed contacts is prevented. Thereby the end location stop functionality is attained in both directions by one and the same device.

[0017] According to a further preferred embodiment, the wheel includes a plurality of mounting means at different angular positions also for the second end stop unit.

[0018] The flexibility to adapt the end location stop to tap changers of different numbers of fixed contacts thereby is further increased.

[0019] According to a further preferred embodiment, the wheel is a Geneva wheel.

[0020] The wheel thereby is arranged for drive by a Geneva mechanism, which is particularly suitable for achieving stepwise rotational movement.

[0021] According to a further preferred embodiment, the Geneva wheel has at least 36 driving slots.

[0022] With that number of driving slots, the end location stop device will be suitable for up to 35 fixed contacts. The device thus covers the range of number of fixed contacts within which almost all tap changers operate.

[0023] According to a further preferred embodiment, the wheel includes at least 36 mounting means at different angular positions.

[0024] Also this embodiment is particularly suitable for applying the invention to the range of numbers of fixed contacts that in most cases is used.

[0025] According to a further preferred embodiment, all mounting means are identical to each other.

[0026] This simplifies the mounting of the end stop units to the respective selected mounting means.

[0027] According to a further preferred embodiment, all mounting means are located on the same radius.

[0028] This provides a uniform design of the wheel and simplifies its manufacturing. The cooperation between the stop units and the locking link will also be the same at any angular location of the respective stop unit.

[0029] According to a further preferred embodiment,

each mounting means is an axial hole through the wheel.

[0030] This provides a very easy way of mounting the respective end stop unit in one of the mounting means. Axial here refers to the axis of the wheel.

[0031] According to a further preferred embodiment, each end stop unit is a screw and each hole is threaded for cooperation therewith.

[0032] The respective end stop unit thereby can be mounted in a very easy way to the selected hole of the wheel. By the threading the end stop unit will be secured in place.

[0033] According to a further preferred embodiment, the locking link is pivotally mounted around a pivot axis in parallel to the axis of the wheel, which pivot axis is located outside the periphery of the wheel, which locking link has a free end located adjacent the wheel on the side thereof on which each end stop unit is located, which free end reaches radially inside the position of each mounting means.

[0034] The locking link thereby in a simple manner can transfer the movement when hit by an end stop unit to lock the drive of the diverter switch.

[0035] The invention also relates to a transformer that includes a tap changer according to the present invention, in particular to any of the preferred embodiments thereof.

[0036] According to the second aspect of the invention, the method specified in the introduction of the present description includes adapting the end location stop device for use for different numbers of fixed contacts, which adaption includes the following specific steps:

- providing a wheel and a first end stop unit,
- arranging a plurality of mounting means on the wheel,
- selecting one of the mounting means in dependence of the number of fixed contacts in the tap selector,
- mounting the first end stop unit in the selected mounting means.

[0037] According to preferred embodiments, the method is performed on a tap changer according to the present invention, in particular to any of the preferred embodiments thereof.

[0038] The invented transformer and the invented method have advantages similar to those of the invented tap changer and the preferred embodiments thereof, which advantages have been described above.

[0039] The above described preferred embodiments of the invention are specified in the dependent claims. It is to be understood that further preferred embodiments of course can be constituted by any possible combination of the preferred embodiments above and by any possible combination of these and features mentioned in the description of examples below.

[0040] The invention will be further explained through the following detailed description of an example thereof and with reference to the accompanying drawings.

Short description of the drawings

[0041]

Fig. 1a - 1c schematically illustrate a tap changer according to the present invention.

Fig. 2 is an end view of the main parts of the end location stop of the tap changer in fig. 1a - 1c.

Fig. 3 is a section along line III-III of fig. 2 in an enlarged scale.

Description of examples

[0042] Fig 1a - 1c schematically illustrates a tap changer. Fig. 1a is a single-phase diagram of a tap changer 100 of a kind for which the device according to the present invention is intended. The tap changer 100 is connected to a regulating winding of a transformer and has a set of different taps 102, in this case the number of taps is 16, but the number might be some other, for example any number from 5 to 35. The tap changer of fig. 1a is of diverter switch type, and comprises a diverter switch 120 and a tap selector 110.

[0043] The tap selector 110 of Fig.1 operates with pre-selection and fine selection, and thus comprises a pre-selector arm 51 and a fine selector arm 101. Both the pre-selector arm 51 and the fine selector arm 101 operate by a respective rotational movement as illustrated in fig 1b and 1c. The pre-selector arm 51 is movable between two fixed contacts and each fine selector arm 101 can be brought into contact with either of 5-9 different fixed contacts. The combined positioning of the pre-selector arm 51 and the fine selector arm 101 thereby represents up to 35 different taps.

[0044] The diverter switch 120 in a known manner has a set of breakers, e.g. vacuum breakers. When it is required to change from one tap to another, these breakers are opened and closed in a certain sequence. This allows the selector arms 51, 101 to respectively move from one fixed contact to an adjacent fixed contact.

[0045] Fig. 2 in and end view illustrates the main components of an end location stop according to an example of the invention. A wheel 34 in the form of a Geneva wheel is mounted rotatable around an axis 49. The Geneva wheel has a plurality of driving slots 35. In the illustrated example the number of driving slots 35 is 36. The Geneva wheel is driven by a gear wheel 31 mounted to the shaft 30 that drives the selector arm (not shown). A chain 32 transmits rotation of the gear wheel 31 to the Geneva drive wheel 33, which is in Geneva drive connection with the slots 35 of the Geneva wheel 34.

[0046] The Geneva wheel 34 has a plurality of mounting means 36 for end stop units 43a, 43b. In this example each mounting means is a threaded hole 36 extending axially through the Geneva wheel 34 and located on a common circle. In the figure a first end stop unit 43a is mounted in the hole 36a and a second end stop unit 43b is mounted in the hole 36b.

[0047] A locking link 37 is arranged to cooperate with the end stop units 43a, 43b on the Geneva wheel 34. The locking link is turnable around a pivot axis 38. A free end 39 of the locking link reaches radially inside the Geneva wheel 34 beyond the circle on which the holes 36 are located. The free end 39 of the locking link 37 is closed enough to the Geneva wheel 34 to interfere with the end stop units 43a, 43b. The other end of the locking link is by a joint 40 connected to a transmission link 41 arranged to activate the drive lock 42 for the diverter switch shaft (not shown). The drive lock is activated both by upwards and downwards movement of the transmission link 41.

[0048] When the shaft 30 moves the selector arm one step, the drive connection to the Geneva wheel 34 results in that the Geneva wheel will turn one slot step in a direction that is determined by in which direction the selector arm has moved. If the Geneva wheel 34 rotates one slot step in the clockwise direction in the figure, the end stop unit 36a will move angularly towards the locking link 37 a corresponding angle. After a number of fine selector arm movements, where movements in one direction dominates, the end stop unit 43a will come close to the locking link 37. When the fine selector arm has reached one end contact of the fixed contacts, the end stop unit 43a will be positioned closed to the locking link 37. In case the tap changer is commanded to move further in the same direction, i. e. beyond the end contact, further rotation of the Geneva wheel will result in that the end stop unit 43a abuts the free end 39 of the locking link 37. This results in that the locking link 37 will be turned around its pivot axis 38 and via the transmission link activate the drive lock 42 such that actuation of the diverter switch is prevented.

[0049] Correspondingly the other end stop unit 43b will act on the locking link 37 in the opposite direction, when the end contact at the other end is reached.

[0050] The position of the end stop units 43a, 43b in the figure is adapted for a number of fixed contacts that is 35. For use in an application where the number of fixed contacts is lower, the end stop units 43a, 43b are mounted in other holes 36, having positions adapted to the number of fixed contacts. Should the number of fixed contacts be 29, the end stop units 43a, 43b are mounted in holes 36c and 36d, respectively. With a number of fixed contacts of 21, the holes 36a, 36f would be used for mounting the end stop units 43a, 43b, etc.

[0051] Fig. 3 is a cross section along the line III-III of fig. 2. The hole 36a has a thread 45, and the end stop unit 43a is made as a screw with a corresponding thread 47. The head 48 of the screw 43a is the part that is arranged to abut the locking lever 37.

Claims

1. A tap changer (100) including a diverter switch (120) and a tap selector (110), which tap selector (110) has a plurality of fixed contacts (102) and a pair of

- fine selector arms (101) with a movable contact for selective engagement with any one of the fixed contacts (102), which tap changer includes an end location stop device having a locking link (37) and a rotatable wheel (34), which wheel (34) is arranged to turn a certain angle when the fine selector arm (101) moves from one fixed contact to an adjacent fixed contact, and which wheel (34) on one side thereof is provided with a first end stop unit (43a) arranged to abut the locking link (37) when the fine selector arm (101) moves beyond a first end contact of said fixed contacts (102), whereby the locking link (37) is arranged to lock drive of the diverter switch (120) when said first end stop unit (43a) abuts the locking link (37), **characterized in that** the wheel (34) includes a plurality of mounting means (36) for said first end stop unit (43a), which mounting means (36) are located at different angular positions
2. A tap changer (100) according to claim 1, **characterized in that** the wheel (34) on said one side is provided with a second end stop unit (43b) arranged to abut the locking link (37) when the fine selector arm (101) moves beyond a second end contact of said fixed contacts (102), whereby the locking link (37) is arranged to lock drive of the diverter switch (120) when said second end stop unit (43b) abuts the locking link (37).
 3. A tap changer (100) according to claim 2, **characterized in that** the wheel (34) includes a plurality of mounting means (36) at different angular positions also for the second end stop unit (43b).
 4. A tap changer (100) according to any of claims 1-3, **characterized in that** the wheel is a Geneva wheel (34).
 5. A tap changer (100) according to claim 4, **characterized in that** the Geneva wheel (34) has at least 36 driving slots (35).
 6. A tap changer (100) according to any of claims 1-5, **characterized in that** the wheel (34) includes at least 36 mounting means (36) at different angular positions.
 7. A tap changer (100) according to any of claims 1-6, **characterized in that** all mounting means (36) are identical to each other.
 8. A tap changer (100) according to any of claims 1-7, **characterized in that** all mounting means (36) are located on the same radius.
 9. A tap changer (100) according to any of claims 1-8, **characterized in that** each mounting means is an axial hole (36) through the wheel (34).
 10. A tap changer (100) according to claim 9, **characterized in that** each end stop unit is a screw (43a, 43b) and that each hole (36) is threaded for cooperation therewith.
 11. A tap changer (100) according to any of claims 1-10, **characterized in that** the locking link (37) is pivotally mounted around a pivot axis (38) in parallel to the axis (49) of the wheel (34), which pivot axis (38) is located outside the periphery of the wheel (34), which locking link (37) has a free end (39) located adjacent the wheel (34) on the side thereof on which each end stop unit (43a, 43b) is located which free end (39) reaches radially inside the position of each mounting means (36).
 12. A transformer, **characterized in that** the transformer includes a tap changer (100) according to any of claims 1-11.
 13. A method of arranging an end location stop device of a tap changer (100), which tap changer (100) is of the type including a diverter switch (120) and a tap selector (110), which tap selector (110) has a plurality of fixed contacts (102) and a fine selector arm (101) with a movable contact for selective engagement with any one of the fixed contacts (102), which tap changer (100) includes an end location stop device having a locking link (37) and a rotatable wheel (34), which wheel (34) is arranged to turn a certain angle when the fine selector arm (101) moves from one fixed contact to an adjacent fixed contact and is provided with a first end stop unit (43a) arranged to abut the locking link (37) when the fine selector arm (101) moves beyond a first end contact of said fixed contacts (102), whereby the locking link (37) is arranged to lock drive of the diverter switch (120) when said first end stop unit (43a) abuts the locking link (37), **characterized by** adapting the end location stop device for use for different numbers of fixed contacts (102), which adaption includes the following steps:
 - providing said wheel (34) and said first end stop unit (43a)
 - arranging a plurality of mounting means (36) on said wheel (34)
 - selecting one of said mounting means (36) in dependence of the number of fixed contacts (102) in the tap selector (110)
 - mounting said first end stop unit (43a) in the selected mounting means (36).
 14. A method according to claim 13, **characterized in that** the method is performed on a tap changer (100) according to any of claims 1-12.

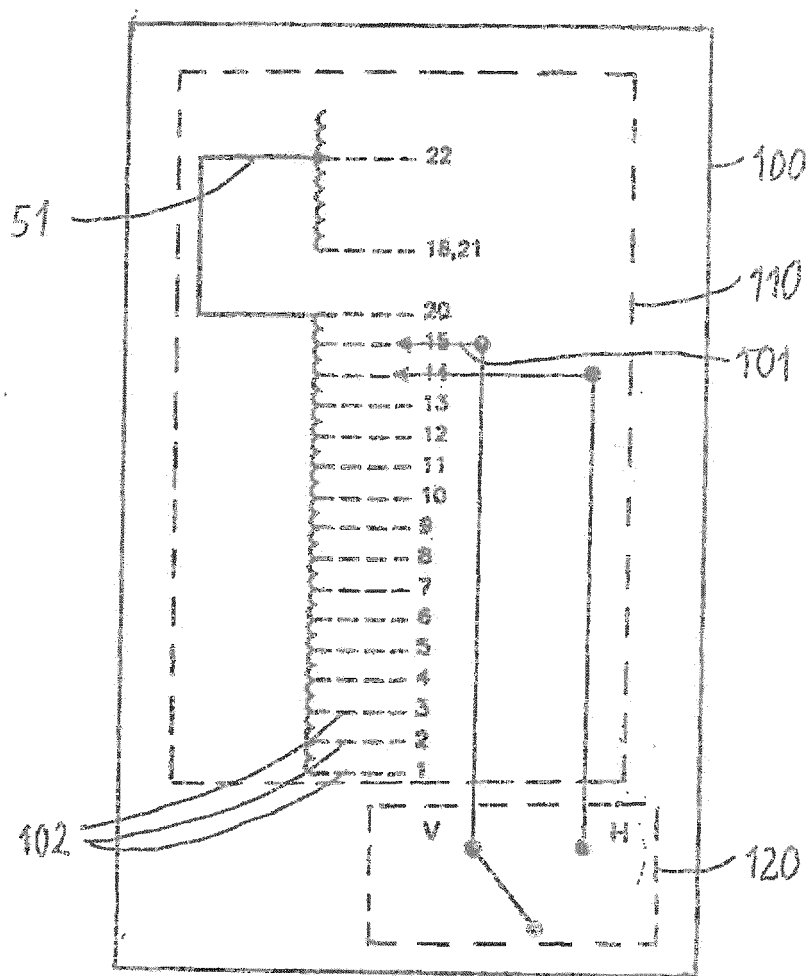


Fig. 1a

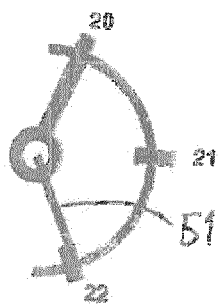


Fig. 1b

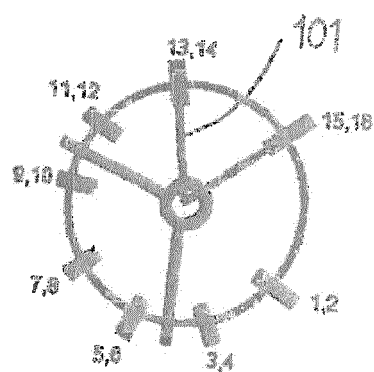
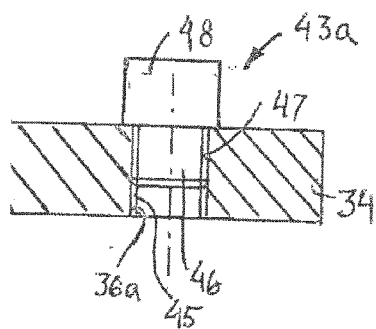
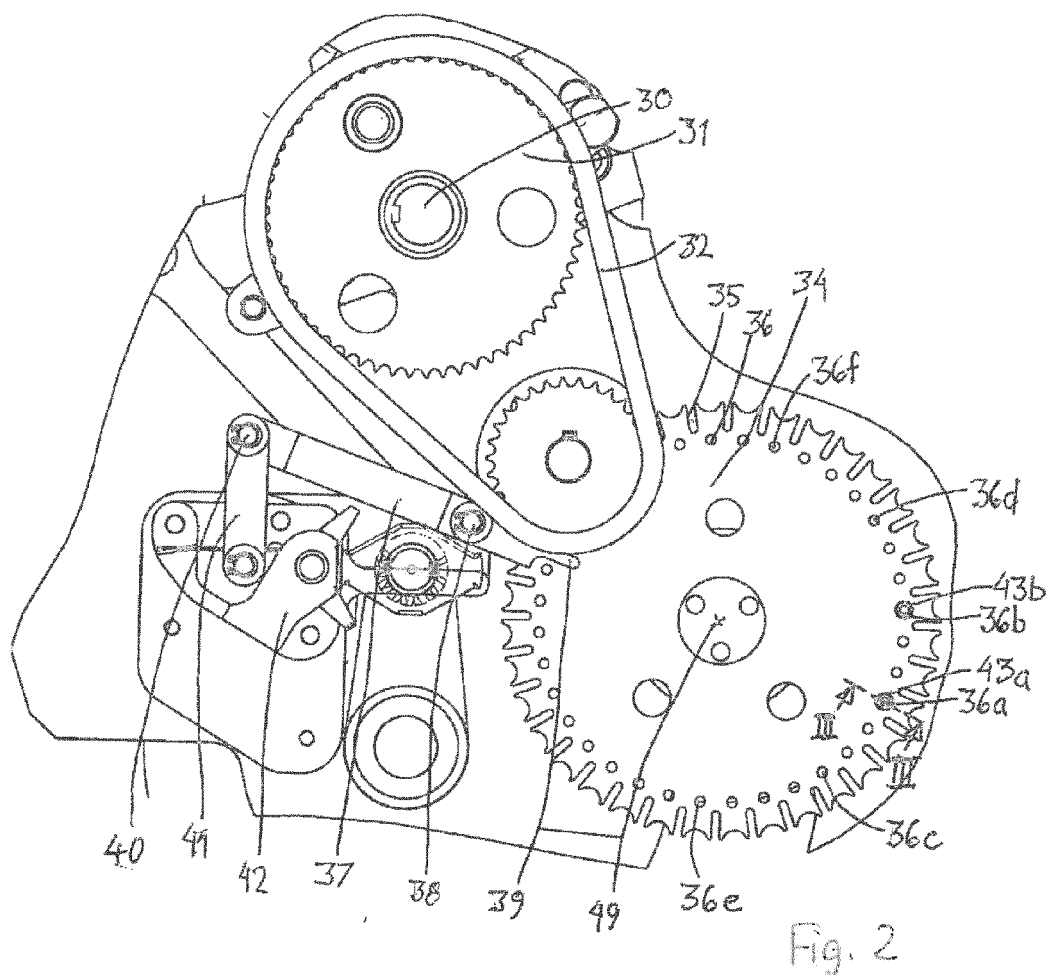


Fig. 1c





EUROPEAN SEARCH REPORT

Application Number
EP 12 15 8241

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 6 693 247 B1 (BYERS CHRISTOPHER J [US] ET AL) 17 February 2004 (2004-02-17)	1,13,14	INV. H01H9/00
A	* paragraphs [0060], [0061]; figure 10b *	2-12	ADD. H01H3/44
Y	DE 10 39 129 B (SIEMENS AG) 18 September 1958 (1958-09-18) * column 3, line 5 - column 4, line 13; figure 1 *	1,13,14	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 30 July 2012	Examiner Simonini, Stefano
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 15 8241

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

30-07-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6693247 B1	17-02-2004	US 6693247 B1	17-02-2004
		US 6833518 B1	21-12-2004
DE 1039129 B	18-09-1958	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 5165295 A [0007]
- US 6060669 A [0007]
- US 7750257 B [0007]
- US 2011005816 A [0010]