



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
31.07.2013 Bulletin 2013/31

(51) Int Cl.:
H01Q 1/12 (2006.01) H01Q 19/30 (2006.01)

(21) Application number: **12382021.9**

(22) Date of filing: **24.01.2012**

(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

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(54) **System and method for reducing interferences in television signals receiving systems**

(57) The present invention relates to a system and method for reducing interference in television signals, particularly interference caused by new services (such as mobile internet services, LTE telephony services...). The present invention solves easily the drawbacks of the

existing systems, particularly in the cases (digital dividend, white spaces) wherein the signals of these new services are so close to the television channels that filtering is not a viable solution (due to the lack of effectiveness and/or economic reasons).

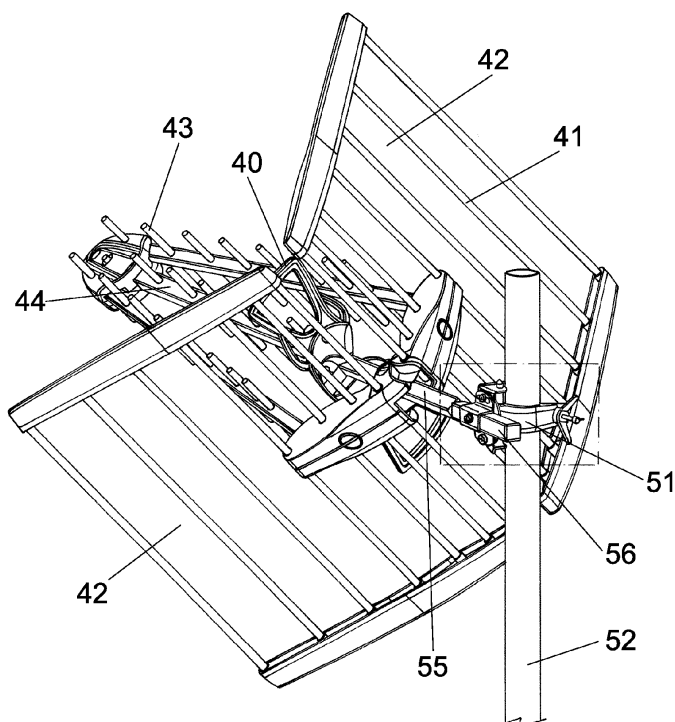


FIG. 4

Description

Technical Field of the Invention

[0001] The present invention has its field of application in reducing interferences in signals received by antenna systems and more specifically, in reducing interferences in antenna systems which receive television signals.

Background of the Invention

[0002] The compression systems of the current digital television systems allow transmitting several normal digital television channels (usually up to six according to the coding and modulation techniques used) of acceptable quality in the radio-frequency space previously used by a single analogue channel. There are usually four or five terrestrial analogue services per region and, therefore, the use of a single digital television channel for all of them will significantly reduce the use of the spectrum. The difference between the amount of spectrum used in the analogue systems (11) and the amount of spectrum used in digital systems (12) to accommodate existing analogue services, and which therefore, has been released by changing from analogue to the digital television (after a transition period (15) where the two technologies were used), is what is called digital dividend (13), which is illustrated in Figure 1. A comparison of the spectrum (14) taken up by the previous analogue systems with respect to the current digital systems is depicted therein.

[0003] New coding, compression and modulation techniques for digital terrestrial television broadcasting (such as those proposed in various recommendations of the International Telecommunication Union, ITU) have indirectly contributed to the process of creating this so called digital dividend. For example, the pioneering ITU-R BT. 798 Recommendation stipulates "that digital terrestrial television broadcasting should fit in the channels (6, 7 and 8 MHz) intended for analogue television emission in the very high frequency and ultrahigh frequency wave bands". That Recommendation, which prohibits the bandwidth used for digital programmes to be larger than the bandwidth of the analogue channels, has paved the way for the development of advanced digital compression techniques.

[0004] In other words, the digital dividend is due to the fact that the digital compression systems allow multiplexing the transmission of several television programmes in the spectrum previously used by a single analogue television channel. This means that the possibilities of accessing the digital dividend spectrum keep increasing, as more advanced terrestrial television standards for infrastructure and compression (for example, the second generation of digital terrestrial television broadcasting transmission systems, DTT) offering a greater binary capacity per hertz than the existing systems, are gradually developed and introduced.

[0005] The amount (quantity) of released spectrum

with the change from analogue to digital transmission mainly depends on national particularities such as geography and topography of the country, degree of penetration of digital transmission services, needs for regional or minority television services, and use of the spectrum in the neighboring countries. This amount also depends on digital television technology adopted for replacing the analogue services. Therefore, the size of the digital dividend changes from one region to another and from one country to another. Although the specific location of the digital dividend also varies from one country (or region) to another, since it depends on the assigned frequencies of each country/region, it is usually placed between 200 MHz and 1 GHz. This released band (dividend) is placed in the range between 790 and 862 MHz, particularly in Europe.

[0006] The spectrum created with this digital dividend can be used for all types of services, such as additional terrestrial radio-television services (which could even include the delivery of new interactive and high definition television programmes), mobile multimedia applications, mobile communications, wireless broadband access systems (could be used for example for offering ubiquitous broadband Internet access to areas not yet reached by landlines, helping to reduce the digital divide) etc. In other words, it could be said that this spectrum is the opportunity to respond to the growing demand for new wireless communication services.

[0007] But it is the mobile telephony sector which is most interested in the use of this digital dividend given the number of new mobile services which are being offered in this sector (mobile television, internet access through mobile terminals, high-volume data transmission...). The freed frequencies in the digital dividend (as has been said above tend to be in the band between 200 MHz and 1 GHz) also have signal propagation characteristics greater than those at, for example, 2.4 GHz and the sector has expressed interest in using these lower frequencies to facilitate the coverage and, therefore, achieve an optimum balance between the transmission capacity and the operational reach. Fewer infrastructures would thus be needed to obtain a wider mobile coverage, with the consequent reduction of the costs of communication services, particularly in rural areas. Due to all this, in many countries where the television transmission has been changed from analogue to digital, the released spectrum has been assigned by and large to mobile telephony communications and particularly, to new generation mobile telephony transmissions, known as LTE (Long Term Evolution) mobile communication, or also for other types of technology such as 4G or WiMAX mobile telephony.

[0008] This freed spectrum (digital dividend) due to the change from analogue to digital television (as can be seen in Figure 1) which will be assigned to this other type of aforementioned new services (wireless internet, mobile telephony...), will be very close to the frequency band used in the digital terrestrial television service. And a se-

rious problem will arise herein, since the digital terrestrial television signals (DTT) will be interfered by the signals of these new services, with the consequent deterioration of the television service quality. This will be particularly problematic in those television channels which are at the end of the band dedicated to television, i.e., in the area bordering with the released spectrum band.

[0009] This very problem of interference arises as well with the so called white spaces, the concept of which will be explained now. As it is known, frequency channels (for example television channels) are assigned by geographical areas. To avoid interferences between the channels assigned in a specific geographical area and those assigned to the adjacent geographical areas, there are television channels which are not assigned and are free in each geographical area. These free channels can be used for other services, especially inside (not in the borders of) the assigned geographical areas, where they would not interfere with the adjacent geographical areas. These free channels are called "white spaces", which can be used by other services (usually advanced mobile telephony services such as LTE, mobile internet...). These white spaces tend to be used in a dynamic manner such that when a user is in a specific geographical area, he/she consults the white spaces (unassigned channels) of that area in a database and uses them for the mentioned services. In other words, these white spaces are channels within the frequency range of the television channels but which are free and unassigned in a specific geographical area. These white spaces by definition will therefore be close to the television channels which are indeed assigned and are not free.

[0010] The fact of using frequency channels very close to digital television channels for these services causes the same problems of interferences explained above for the digital dividend (even more serious problems, because these white space channels are interbanded and therefore much more closer to those used for digital television than those of the digital dividend).

[0011] In both cases (digital dividend and white spaces), the interference caused by these new signals in the digital television signals will be significant since they are also signals of a very different type with respect to those of digital television and very close to them (in some cases, less than 1 MHz), causing the following unwanted effects:

- On one hand, since they are signals of great power compared to television signals, they tend to saturate the broadband amplifiers and the tuners of the television receiver system.
- On the other hand, these signals tend to have a bandwidth occupying frequencies outside the assigned channel causing interference (co-channel interference) in the television channels consequently deteriorating the signal to noise ratio of the received television signal.

[0012] Very discriminating filters separating the digital

television signals from the unwanted signals (the signal of new services) could be used to improve digital television signal reception. But this, besides making the digital television receiving system considerably expensive, would not solve the problem entirely since the signals of these new services, due to its frequency distribution, will cause a very prominent noise signal in the digital television channels which would not be eliminated with the help of these filters (co-channel interference).

[0013] It would also be possible to solve this problem (or to at least reduce its seriousness), by increasing the power with which the television signal is received (for example, by means using repeaters), but this would be a very expensive solution.

[0014] If the television signals and the signals of these new services had orthogonal polarizations (planes of propagation), eliminating the unwanted signal would be possible with an antenna with a polarization corresponding to that of the TV signals which, ideally, would not collect the signal of these services since they have an orthogonal polarization. But in practice the signals of those services do not have a polarization purely orthogonal to that of television, so although a specific polarization antenna is used, part of the interfering signal will affect that of television (for example, the LTE signals tend to have oblique polarizations at 45° and are therefore not orthogonal to the polarizations of the television signal, which are usually performed in the horizontal plane of propagation and sometimes in the vertical plane of propagation).

[0015] There can be seen in Figure 2 a profile view (2a) and a frontal view (2b) of an antenna system which is used for television signal reception mainly in the UHF band (in the example of the figure, a Yagi type antenna), arranged in a position making it having a vertical polarization (i.e., having maximum sensitivity to signals with vertical polarization, such as that depicted in Figure 6a). In these drawings the position of the antenna is shown on the left and, the corresponding position of the dipole on the right (25), in both cases with respect to the ground plane (26).

[0016] There can be seen in Figure 3 a profile view (3a) and frontal view (3b) of an antenna system which is used for television signal reception mainly in the UHF band (in the example of the drawing, a Yagi type antenna), arranged in a position making it having a horizontal polarization (i.e., having maximum sensitivity to signals with horizontal polarization such as that depicted in Figure 6b). In these drawings the position of the antenna is shown on the left and the position of the corresponding dipole on the right (35), in both cases with respect to the ground plane (36).

[0017] The current digital television reception systems do not contemplate this problem and therefore assigning the digital dividend and white spaces for new services will involve a significant deterioration in the digital television service currently provided.

[0018] A system solving the problem of worsening re-

ception quality of the digital television service in the previously considered scenario cheaply and efficiently is therefore necessary. And this is the purpose of the present invention.

Summary of the Invention

[0019] The present invention proposes an antenna system (e.g., TV signal reception) solving the problems of the existing systems in a simple manner. Particularly in the cases explained above (digital dividend, white spaces) where the unwanted communications signals are so close to the television channels that filtering is not a viable solution (due to the lack of effectiveness and/or economic reasons). This occurs for example, in the case of wanting to receive a TV channel 60 (782 to 790 MHz) and there is a telephony emission in the band of 791 to 796 MHz.

[0020] In a first aspect, the present invention describes an antenna system for optimal television signals reception consisting of a television signal receiving directional antenna comprising at least one dipole, said directional antenna being pointed in a specific direction, called antenna pointing axis, which will be the direction in which the antenna has maximum sensitivity to the received signals

and a fixing system which allows fixing the antenna to a mast, said fixing system comprising a first fixing element fixed to the mast, said antenna system being **characterized in that** said fixing system further comprises:

- a fixing rotating element attached to the first fixing element at one end and to the antenna at the other end, said fixing rotating element being able to be continuously rotated about an axis of rotation in any rotation position, said axis of rotation coinciding with the antenna pointing axis, said fixing rotating element being attached or joined to the antenna, so the rotation of said fixing rotating element causes the continuous rotation of the antenna about its pointing axis,
- a rotation blocking device which allows blocking the rotation of said rotating element, and therefore of the antenna, in a desired rotation position.

[0021] In one embodiment of the present invention, the antenna pointing axis (also called antenna axis) is perpendicular to the mast.

[0022] In one embodiment of the present invention, the desired rotation position in which the rotating element is blocked with the blocking device is that in which the received power of the television signal is maximum or that rotation position in which the received power of interfering signals is minimum or a compromise between these criteria.

[0023] In one embodiment of the present invention, the antenna is a directional antenna with planar polarization, for example Yagi type and the signals received are digital

television signals, for example in the UHF frequency band, particularly in the frequency range between 470 MHz and 821 MHz and more particularly in the frequency range between 470 MHz and 790 MHz.

[0024] In one embodiment of the present invention, the antenna comprises at least one longitudinal rod, the dipole being mounted on said at least one rod, at least one reflective element and at least one directing element, and where said at least one rod together with the at least one directing element determine the antenna pointing axis, said at least one rod being able to be a central rod in the direction of the antenna pointing axis.

[0025] In one embodiment of the present invention, the blocking device is a screw which prevents the rotation of the rotating element when tightened and the rotating element can be a first longitudinal rod in a direction coinciding with the antenna pointing axis, which can rotate about said axis; in this case the first fixing element can include a second longitudinal rod without the possibility of rotating, said second longitudinal rod being a prolongation of the first longitudinal rod and attached to said first rod, and where the first and second rod have hollow sections in which there is included a round section, fixed to the second rod and free in the first rod, allowing the rotation of the first rod about the second rod.

[0026] In a second aspect, the present invention describes a method for reducing interference in television signals which uses an antenna system such as that of any of the embodiments described above in the first aspect, said method comprises the following steps:

- a) connecting measurement equipment to the antenna which collects the levels of the signals (e.g. power level) captured by the antenna
- b) rotating the rotating element and, therefore the antenna, collecting with the measurement equipment the levels of the signals captured by the antenna in each rotation position
- c) selecting a rotation position according to the levels of the signals captured by the antenna in each rotation position
- d) blocking the rotating element of the antenna in the selected rotation position with the blocking device

[0027] In one embodiment of the present invention the rotation position in which the received power of the television signal is maximum is selected in step c) or in an alternative embodiment, the rotation position in which the received power of the interfering signals is minimum is selected in step c) (a compromise between both positions, if they do not coincide, is also possible), the interfering signals in question being for example, LTE communications signals although interfering signals of any other type is possible.

[0028] The following specification and the attached drawings can be referred to for a more complete understanding of the invention, its objects and advantages.

Description of the Drawings

[0029] To complement the description which is being made and for the purpose of aiding to better understand the features of the invention according to several practical embodiments thereof, a set of drawings is attached as an integral part of said description in which the following has been depicted in an illustrative and non-limiting character:

Figure 1 shows a graph explaining the concept of digital dividend.

Figure 2 shows a profile view (2a) and a frontal view (2b) of a television reception antenna with vertical polarization, together with a schematic view of the position of the dipole of said antenna.

Figure 3 shows a profile view (3a) and a frontal view (3b) of a television reception antenna with horizontal polarization, together with a schematic view of the position of the dipole of said antenna.

Figure 4 shows a television reception antenna according to an embodiment of the present invention.

Figure 5 shows an enlarged and detailed section of a television reception antenna according to an embodiment of the present invention.

Figure 6 shows a schematic depiction of a signal with vertical polarization (6a) and horizontal polarization (6b).

Detailed Description of the Invention

[0030] Figure 4 shows an example of television reception antenna system according to one embodiment of the present invention. Said antenna would prevent the problems (co-channel interference, noise, saturation of amplifiers) which are produced in television signal reception, particularly in the cases where the telephony signals are very close to the television channels (the aforementioned digital dividend and white space scenarios) by allowing a very significant reduction of the ratio between the telephony signal received by the antenna and TV signal (greater than 15 dB in most cases).

[0031] In one embodiment of the present invention, the antenna would be a digital television signal receiver antenna for receiving digital television signals (although they could also be analogue) in the frequency range of the UHF band, in the entire band or in sections of the band and more specifically in the frequency range comprised between 470 and 821 MHz.

[0032] In one embodiment, the UHF digital television signal reception antenna is a flat polarization antenna, and particularly a Yagi type antenna (as the ones shown in Figures 2 and 3). Antennas of this type use to be made up of a main active element, in most cases a dipole (20, 30, 40), followed at a certain distance at one side by a reflector formed by an association of conducting rods (21, 31, 41) (forming reflective grids 22, 32, 42 in many cases) and on the other side of the dipole (the side opposite to

the reflector), a number of directing elements (23, 33, 43). All these components are mounted on a rod or rods (24, 34, 44) determining, according to their position, an axis which will be the direction in which the antenna has maximum sensitivity to the received signals (i.e., those signals whose direction of propagation coincides with said direction will be received with maximum sensitivity). This will be the axis of the main antenna lobe or in other words, the direction in which the antenna points (therefore, it can also be called antenna axis or antenna pointing axis). As it is logical, said axis must ideally be aligned with the trajectory of the radio-frequency signals to be received (the direction of signal reception trajectories being the one going from the directing elements towards the reflector passing through the dipole). In some cases this alignment of the axis with said trajectory (of the wanted radio-frequency signals) is not performed in an exact manner (i.e., the axis deviates a little from this "ideal" alignment) because, due to an interference source, the "ideal" alignment leads to a substantial increase in the received interference.

[0033] As it is known, in this type of flat polarization antennas, the plane formed by the antenna axis together with the dipole axis determine the plane of polarization (or simply called the polarization) of the antenna, i.e., the plane of propagation (or polarization) of the signal for which the antenna has maximum sensitivity. In other words, the signal captured by the antenna will be maximum for those signals whose polarization (plane of propagation) coincides with that of the antenna and minimum for those signals whose plane of polarization is orthogonal to the plane of polarization of the antenna.

[0034] As mentioned above, the transmission of new generation telephony signals (LTE) tend to use, in the downlink, plane of propagations which are inclined around 45° with respect to those of TV, i.e., inclined +/- 45° with respect to the horizontal or vertical plane.

[0035] The antenna fixing systems currently used for DTT television signal reception (e.g. in the UHF band) are usually provided with anchoring or fixing systems for anchoring or fixing to the mast, which only allow pointing in any of the two plane of propagations of the TV signal (horizontal or vertical) but not in others. Neither does it allow a specific adjustment within the chosen plane. In other words, it only has 2 positions (vertical Figures 2a, 2b or horizontal Figures 3a, 3b) and neither an adjustment in each plane nor positioning in intermediate planes is allowed.

[0036] This makes that TV antennas (pointed in the horizontal or vertical plane) receive most of the telephony signals, whose plane of propagation is inclined at +/-45° with respect to the horizontal or vertical plane. Furthermore in many cases, the inclination is not exactly 45° so the interference will be even greater in one of the reception planes.

[0037] The basis of the proposed solution is making use of the difference in polarization (plane of propagation) and of the behaviour of the TV antennas to cross

polarization, for which they usually have a rejection of around 20 dB to orthogonal polarizations. A TV reception antenna will thus receive a specific signal from the TV channels and also a telephony signal. Starting from this situation, changing the polarization of the TV reception antenna is achieved in one embodiment of the present invention, such that it forms 90° with the polarization plane of the telephony antenna thus rejecting a telephony signal of around 20 dB since it has a polarization orthogonal to the reception plane. This can certainly cause a small loss in television signal reception as the antenna is not perfectly oriented in the plane of propagation of the television signal (horizontal (Figure 6b) or vertical (Figure 6a)) but this loss tends to be 3 dB as maximum in the TV signal. In other words, with the proposed embodiment, the ratio between the telephony signal (interfering) and TV signal is reduced around 17 dB, and, in practice, these values can be larger.

[0038] However, as has been mentioned above, the current reception antennas only allow a horizontal or vertical positioning so it is not possible for them to point in a manner in which they form 90° with the emission plane of the telephony antenna. Furthermore, the inclination of the reception plane of the unwanted signals (e.g. telephony signals) does not always have to be exactly 45° but the exact inclination depends on the particular scenario in which the reception occurs (so other deviations with respect to this inclination or other different inclinations are frequent).

[0039] The present invention responds to this need of continuously adjusting the angle of rotation in the plane of polarization, allowing the antenna to rotate about its axis and position it at any angle in order to find the optimum unwanted signal rejection position (normally 90° with respect to the plane of propagation of the unwanted signal). To that end, in one embodiment of the present invention (Figure 4, shown more clearly in the enlarged drawing shown in Figure 5), it is added, between the antenna (53) and the anchoring or first fixing element (51) fixed to the mast (52) (said mast has a vertical position although other positions are possible), a fixing rotating element (55), which can rotate about an axis of rotation coinciding with (or parallel to) the antenna axis, the fixing rotating element is joined or connected to the antenna, allowing therefore the continuous rotation of the antenna about its axis, being able to achieve any angle of rotation (rotation position). In some cases the antenna axis is perpendicular to said mast (although it may not be) and therefore, if the mast is vertical the axis of rotation is in the horizontal plane. In the case shown in Figures 4 and 5, this rotating element is a first longitudinal rod (55) in a direction coinciding with the antenna pointing axis, although certainly any other rotating element performing the same function is possible.

[0040] The rotating element may be connected in solidarity with the antenna (binded or rigidly connected to the antenna). Generally speaking the connection between the antenna and the rotating element may be any

connection which makes that the rotation of said rotating element causes the continuous rotation of the antenna about its pointing axis.

[0041] Since the antenna is fixed to the mast, a continuous and precise adjustment of the plane of polarization can be made by rotating the antenna about its axis and once the adjustment is achieved (e.g. the plane of polarization is such that the television signal reception is optimum), it is blocked by means of a fixing or blocking system (for example a screw 54) which allows blocking the rotation of the antenna axis (and therefore of its plane of polarization) in any desired rotation position, for assuring the blocking of the adjustment made. With this blocking system, the antenna can be blocked in any desired rotation position.

[0042] This can be done, for example, by dividing the part of antenna which is fixed to the mast into 2 portions, one which is fixed to the mast and does not move (56) and another which can rotate (55) about the portion fixed to the mast of the antenna. In a specific embodiment this can be done by using 2 portions of hollow sections (for example of square portion), such that another round inner section is fitted to these portions, fixed to the first portion (56) and free in the other portion (55) until the screw (54) is tightened. This part of antenna will be longitudinal and coinciding with or parallel to the antenna axis (as can be seen in Figure 4).

[0043] The plane of polarization of the antenna changes gradually as the antenna rotates about its main axis. Then when the antenna reception is to be adjusted, the antenna is rotated about its axis (by rotating the rotating element) and fixed in the position in which the interfering signal rejection is maximum (plane of polarization of the antenna orthogonal to that of the telephony signals) or the TV signal reception is optimum (usually both positions coincide, i.e., where the TV signal reception is optimum is because the interfering signal rejection is maximum). Other adjustment criteria are also possible. Although it can be performed in several ways, to that end it is convenient to have a measurement equipment which indicates the levels of the signals (power level) captured by the antenna and is able to search for the suitable inclination position of the antenna in polarization. At the point in which said measurements indicate that the power of the interfering signals is minimum and/or the received power of the television signal is maximum, the antenna is fixed blocking it in said rotation position.

[0044] Generally speaking the adjustment position will be close to 90° with respect to the plane of propagation of the downlink of the telephony signal to be rejected (e.g. LTE), a situation in which the power of said signal will be minimum.

[0045] It uses to be two antennas with +/- 45° polarization which are orthogonal to each other at the emission point of the telephonic signals, where one emits the first channel (791-796 MHz), the third channel (801-806 MHz) and the fifth (811-816 MHz) and the other, the second (796-801 MHz), the fourth (806-811 MHz) and the sixth

(816-821 MHz). In one embodiment, the system will preferably search for the rejection of the LTE channel whose frequencies are comprised between 791 and 796 MHz (first antenna) and consequently there will also be a rejection of the LTE channels which are transmitted by the same antenna as the latter (the third and the fifth).

[0046] The adjustment can be made manually by a technician when the antenna is installed and every time a check to improve signal reception is carried out. Optionally, the adjustment can be made automatically, providing the system with a motor. This motor can be controlled locally or remotely. In the case of controlling it remotely, the measurements and the adjustment can also be made remotely, which will allow a more frequent adjustment (even continuous) since going to the antenna location to perform the adjustment is not required. Therefore, the antenna can be rotated about its axis such that the TV signal reception is optimum every time it is desired.

[0047] This system also enables a quick and easy change between the polarizations used in TV, valid in the situations where rejecting the LTE is not necessary, but adapting easily and quickly to the situation of the polarization of the TV signal in a specific location is desired. There can also be scenarios where the polarization of the TV signal is not exactly horizontal or vertical and therefore, the reception of said signals is not optimum with the current antennas. With the proposed invention, the plane of polarization of the antenna can be changed until it coincides with the exact polarization of the TV signal.

[0048] To complete the proposed solution, filters for rejecting other signals, particularly those emitted by the other LTE antenna of different polarization can be added. As has been explained above, there may be two antennas with $\pm 45^\circ$ polarization which are orthogonal to each other at the emission point. If the present invention (polarization adjustment) is applied, the rejection of the signals emitted by the antenna emitting the channel closest in frequency (791-796 MHz) is achieved since this channel is the most difficult to reject with filters. The LTE channels emitted by the antenna with orthogonal polarization (not rejected with the present invention, since they have a different polarization) must be rejected with the aid of filters. In this case, the filters do not have to be so discriminating, because the rejected signal it is already more than at least 5 MHz away from the desired signal. In other words, since the main interfering signal (LTE telephony signal in frequencies close to those of television) is already received with little power, these filters would not need to be so discriminating, therefore they would be much more cost effective and affordable to make.

[0049] Finally, TV signal reception is optimized with this adjustment of the plane of polarization of the television reception antennas, even in situations where the interfering signals (telephony signals or signals of other type) are in frequencies very close to those of the television channels.

[0050] Although due to reasons of clarity many of the examples shown refer to Yagi type antennas, this invention is certainly not only applicable to Yagi type antennas but to antennas of any other type, particularly television signal receiving directional flat polarization antennas.

[0051] In documents of the state of the art the concept of antenna includes both the electromagnetic part (i.e., the active, directing elements, reflective elements and in general any electromagnetic element which allows radio-frequency signal reception) and the mechanical part which allows fixing the antenna (to a mast). In this document, as has been seen, the concept "antenna system" is used in its place (for designating the assembly of the electromagnetic part and the mechanical part), whereas the concept of "antenna" has been used for designating only the electromagnetic part. In any case, the definitions of "antenna" and "antenna system" used in the present text should not be interpreted in an excluding manner and other definitions of "antenna" and "antenna system" can be used without departing from the scope of protection of this patent defined by the claims.

[0052] Some preferred embodiments of the invention are described in the dependent claims which are included below.

[0053] In this text, the words "comprises" and its variants (such as "comprising", etc.) must not be interpreted in an excluding manner, i.e., they do not exclude the possibility that what is described may include other elements, steps, etc.

[0054] Having sufficiently described the nature of the invention as well as the manner of carrying it out to practice, the possibility that the different parts thereof could be manufactured from a variety of materials, in a variety of sizes and shapes must be highlighted, those variations recommended by the practice also being able to be introduced in its constitution or method provided that they do not alter the fundamental principle of the present invention.

[0055] The description and the drawings simply illustrate the principles of the invention. It must therefore be noted that the persons skilled in the art could conceive several arrangements which, although have not been explicitly described or shown in this document, represent the principles of the invention and are included within its scope. Furthermore, all the examples described in this document are provided mainly for pedagogic purposes in order to aid the reader to understand the principles of the invention and the concepts provided by the inventor/s to improve the art, and must be considered as non-limiting with respect to such specifically described examples and conditions. Furthermore, all that described in this document relating to the principles, aspects and embodiments of the invention, as well as the specific examples thereof cover the equivalences thereof.

[0056] Although the present invention has been described with reference to specific embodiments, the persons skilled in the art must understand that the above and various other changes, omissions and additions in

the shape and the detail thereof can be performed without departing from the spirit and the scope of the invention as defined by means of the following claims.

Claims

1. Antenna system for optimal television signals reception, consisting of a television signals receiving directional antenna comprising at least one dipole, said directional antenna being pointed in a specific direction, referred to as antenna pointing axis, which will be the direction in which the antenna has maximum sensitivity to the received signals and a fixing system which allows fixing the antenna to a mast, said fixing system comprising a first fixing element fixed to the mast, said antenna system being **characterized in that** said fixing system further comprises:
 - a fixing rotating element attached to the first fixing element at one end and to the antenna at the other end, said fixing rotating element being able to be continuously rotated about an axis of rotation in any rotation position, said axis of rotation coinciding with the antenna pointing axis, said fixing rotating element being attached to the antenna, so the rotation of said fixing rotating element causes the continuous rotation of the antenna about its pointing axis,
 - a rotation blocking device which allows blocking the rotation of said rotating element, and therefore of the antenna, in any desired rotation position.
2. Antenna system according to any of the preceding claims, wherein the antenna is a Yagi type directional antenna and the received signals are digital television signals.
3. Antenna system according to any of the preceding claims, wherein the received signals are in the UHF frequency band.
4. Antenna system according to any of the preceding claims, wherein the received television signals are in the frequency range between 470 MHz and 821 MHz.
5. Antenna system according to any of the preceding claims, wherein the antenna comprises at least one longitudinal rod, the dipole being mounted on said at least one rod, at least one reflective element and at least one directing element, and wherein said at least one rod together with the at least one directing element determine the antenna pointing axis.
6. Antenna system according to any of the preceding claims, wherein the desired rotation position in which the rotating element is blocked with the blocking device is the rotation position in which the received power of the television signal is maximum or the rotation position in which the received power of an interfering signals is minimum.
7. Antenna system according to any of the preceding claims, wherein the blocking device is a screw which prevents the rotation of the rotating element when tightened.
8. Antenna system according to any of the preceding claims, wherein the fixing rotating element is a first longitudinal rod in a direction coinciding with the antenna pointing axis, which can rotate about said axis.
9. Antenna system according to claim 8, wherein the first fixing element includes a second longitudinal fixing rod without the possibility of rotating, said second longitudinal fixing rod being a prolongation of the first longitudinal rod and attached to said first rod, and wherein the first and second rod have hollow sections in which there is included a round section, fixed to the second rod and free in the first rod, allowing the rotation of the first rod about the second rod.
10. Antenna system according to any of the preceding claims, further comprising a motor which allows to rotate automatically and remotely said rotating element.
11. Antenna system according to any of the preceding claims, further comprising at least one filter with a specific bandwidth which rejects those unwanted received signals.
12. Method for reducing interference in television signals using an antenna system according to any of the preceding claims, said method comprises the following steps:
 - a) connecting a measurement equipment to the antenna which collects the levels of the signals captured by the antenna
 - b) rotating the rotating element and, therefore the antenna, collecting with the measurement equipment the levels of the signals captured by the antenna in each rotation position
 - c) selecting a rotation position according to the levels of the signals captured by the antenna in each rotation position
 - d) blocking the rotating element of the antenna in the selected rotation position with the blocking device.
13. Method according to claim 12, wherein in step c) is selected the rotation position in which the received

power of the television signal is maximum.

14. Method according to claim 12, wherein in step c) is selected the rotation position in which the received power of interfering signals is minimum.

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15. Method according to claim 14, wherein the interfering signals are LTE communications signals.

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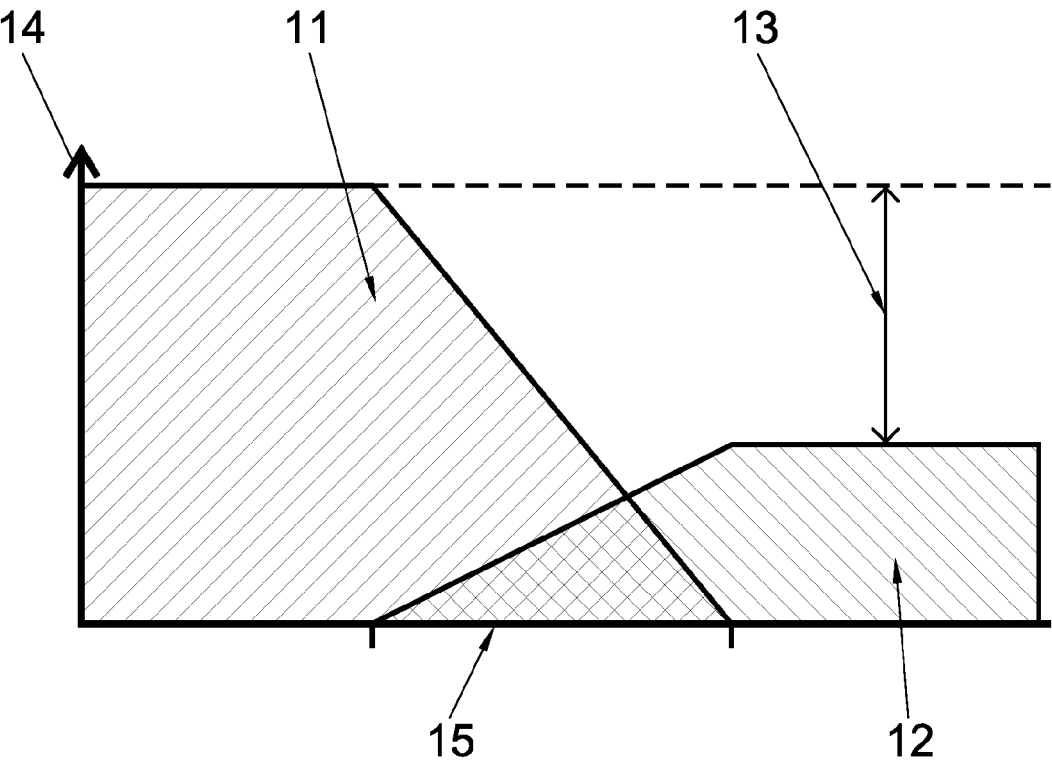


FIG. 1

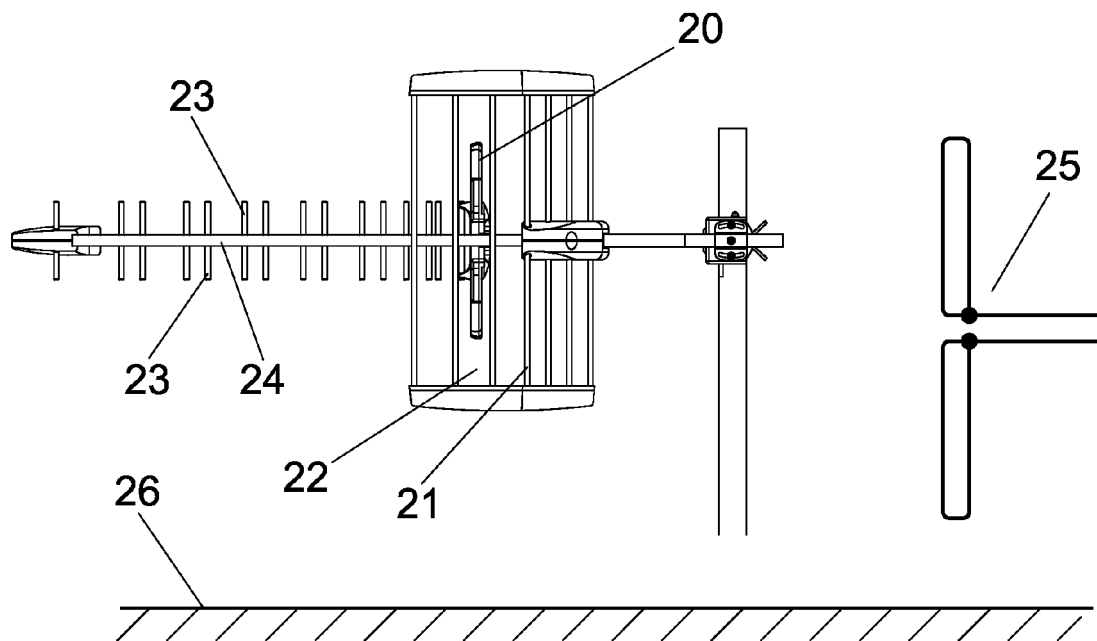


FIG. 2a

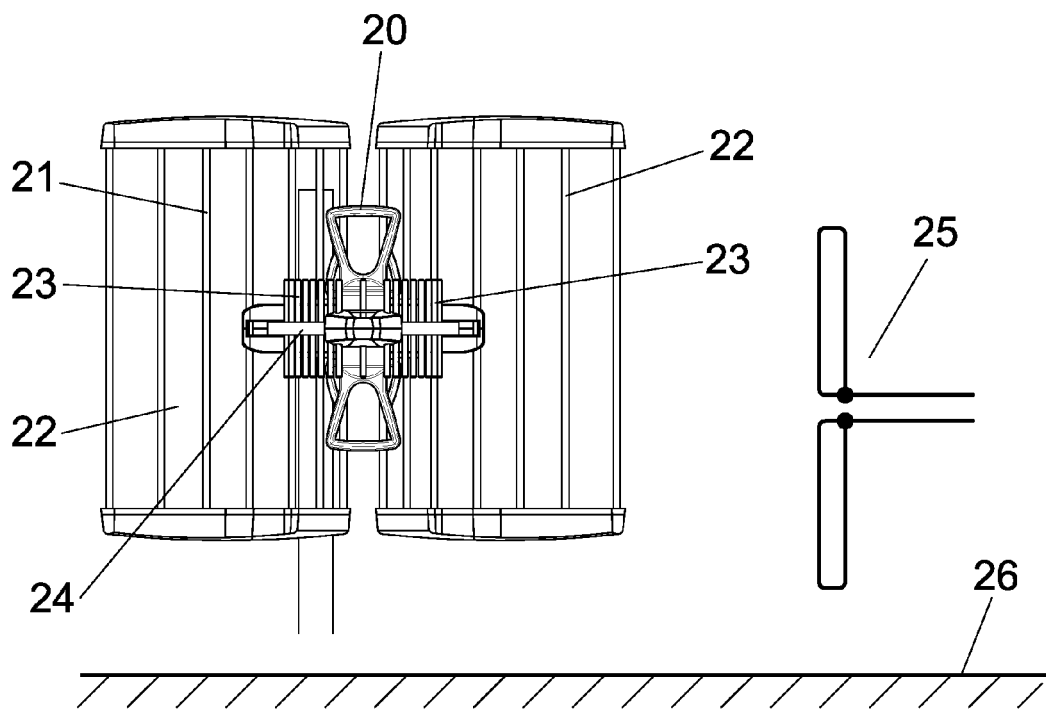


FIG. 2b

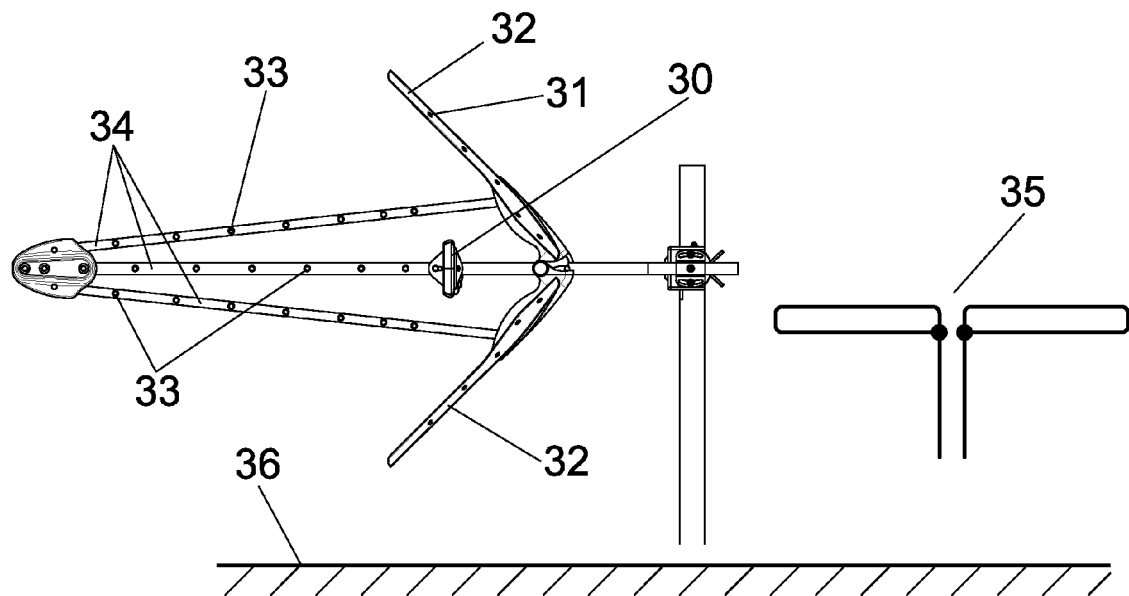


FIG. 3a

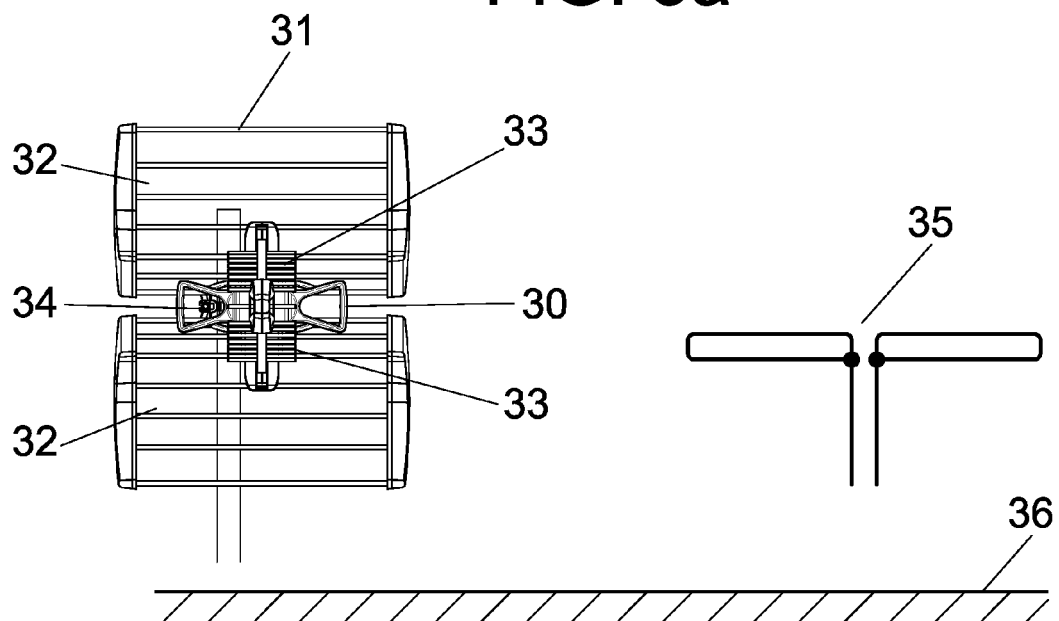


FIG. 3b

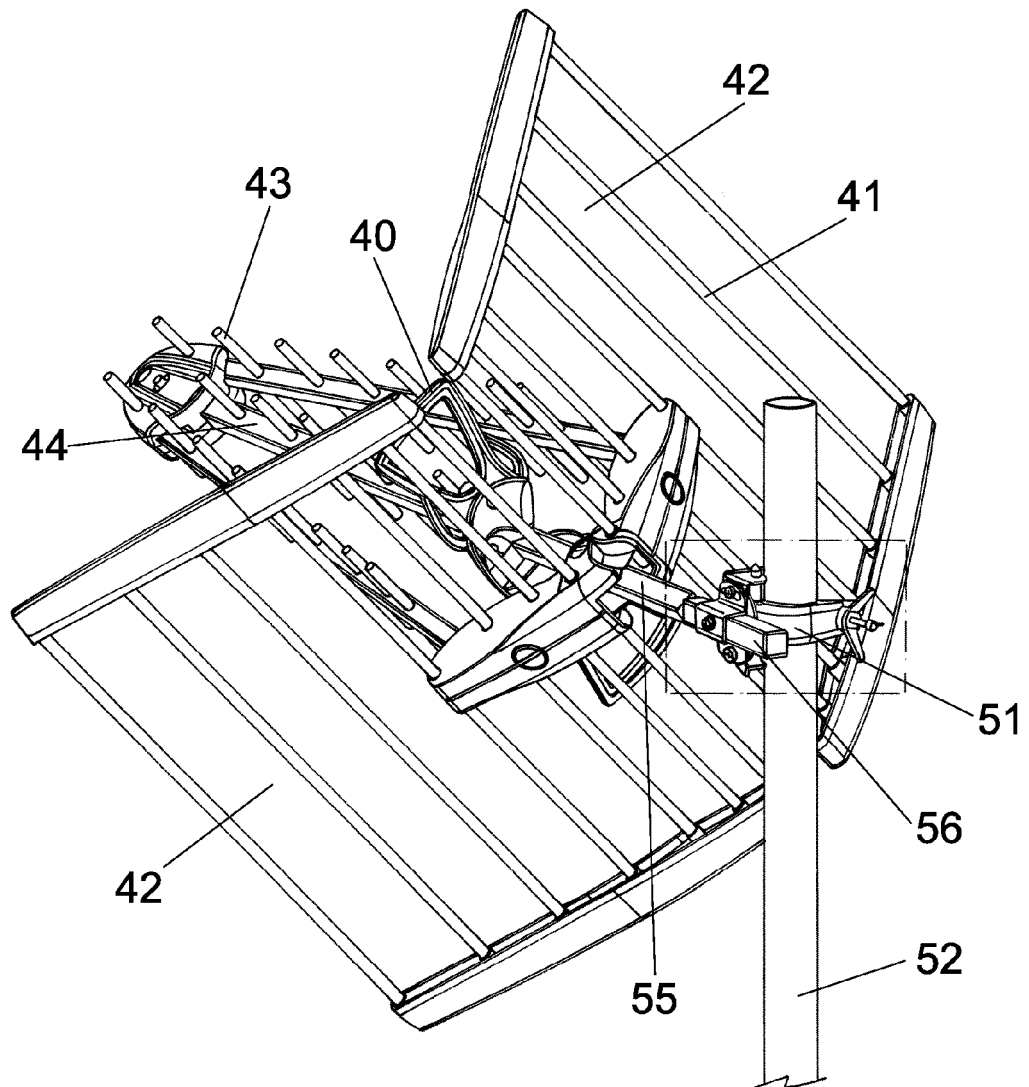


FIG. 4

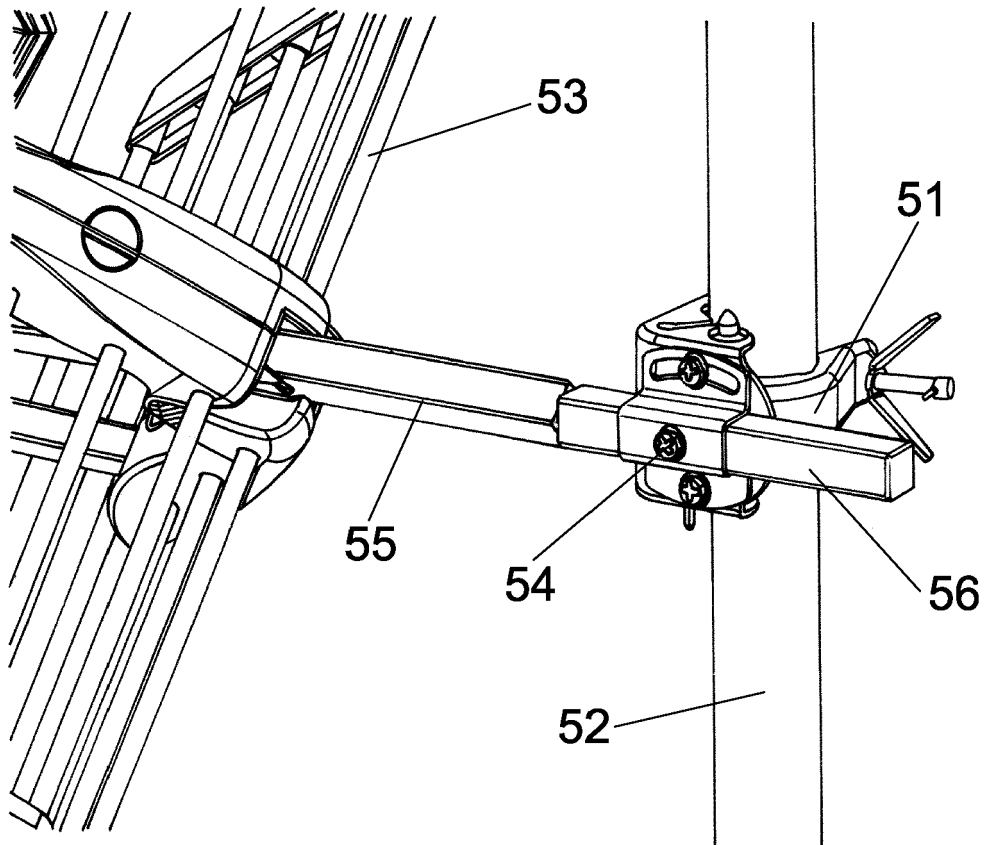


FIG. 5

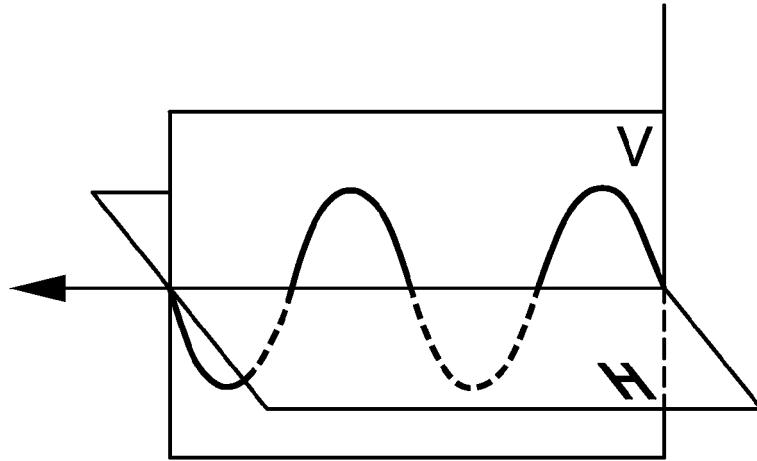


FIG. 6a

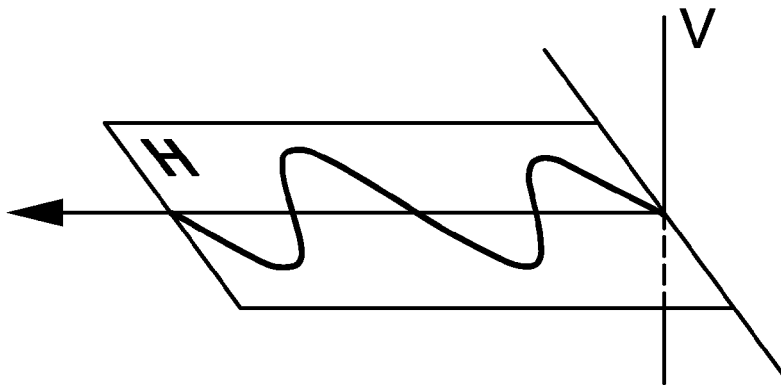


FIG. 6b



EUROPEAN SEARCH REPORT

Application Number
EP 12 38 2021

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	WO 2011/018969 A1 (MASPRO DENKO KK [JP]; YABUSHITA TOSHIO [JP]) 17 February 2011 (2011-02-17) * abstract; figures 1-3 *	1-15	
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3	Place of search Munich	Date of completion of the search 15 June 2012	Examiner Kruck, Peter
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	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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The members are as contained in the European Patent Office EDP file on
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