

DESCRIPTION

TITLE OF INVENTION: [MAST POLE SYSTEM]

TECHNICAL FIELD

[0001] The present disclosure relates generally to the field of mechanical engineering, specifically to the design and operation of a telescopic mast pole system.

BACKGROUND

[0002] The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

[0003] In various sectors, there is a need for structures that can extend to significant heights for a variety of purposes, ranging from surveillance, lighting, mounting antennas, weather testing instruments, environmental test probes, and more. Traditionally, these needs have been met by fixed-height poles or similar structures, which however can be limiting in terms of flexibility and adaptability to different scenarios that demand adjustable heights. Additionally, these conventional structures can pose safety risks during installation, maintenance, and operation due to their height and the force required to manipulate them. Furthermore, these conventional pole structures often need to be custom-made to fit specific height requirements, which can lead to increased production time and costs.

[0004] Although various solutions have been proposed to address the above technical problems, these solutions still face various disadvantages. For example, the European patent application EP3816507A1 “TELESCOPIC MAST” describes a telescopic mast composed of multiple segments, featuring a lifting device with a winch to raise the mast segments via a rope (6). However, this design depends on a securing piece (16) positioned on the lower internal side of an internal segment (9) of the mast. Such an arrangement leads to an uneven pulling force, predominantly affecting one side of the mast (specifically, the side with the safety brake (13)), when the rope (6) is tightened. This uneven force necessitates complex structural adjustments to the mast,

requiring additional stabilizing elements as depicted in Figure 4 of EP3816507A1.

[0005] The Chinese patent document CN209165226U “AN ADJUSTABLE BEACON OF ILLUMINATION” presents an adjustable beacon of illumination, consisting of a connection rod that is flexibly joined at one end to the mast's apex, with the other end rigidly attached to the lighting component. However, this connection rod's adjustability is constrained by predefined positioning holes, thereby limiting the flexibility and range of motion for angling the lighting device. Moreover, the angle of this illumination component must be predetermined and set before elevating the beacon using its hydraulic mechanism, making post-extension angle adjustments problematic. Consequently, if the beacon is fully extended, altering the illumination device's angle becomes a cumbersome task.

[0006] Thus, there exists a need to develop a mast pole structure with better flexibility and adaptability to different scenarios, alleviating, at least to some extent, some of the aforementioned technical problems.

SUMMARY

[0007] Specifically, to address the above-mentioned technical problems, the present invention specifically uses the following technical solutions:

[0008] Accordingly, in accordance with one aspect of the present invention, there is provided a pole system, comprising a Multi-segment Telescopic Mast Pole (MTMP) (01), an extension arm assembly (02) rotatably connected to an upper portion of the MTMP (01), and an angle adjustment means (03) for adjusting rotational angle (α) of the extension arm assembly (02) relative to the axis of the MTMP (01); wherein,

[0009] the extension arm assembly (02) comprises: a mounting bracket (021) installed at the upper portion of the MTMP (01), and a swing arm (022) rotatably connected to the mounting bracket (021);

[0010] the angle adjustment means (03) comprises: a third cable (032) configured to attach to the swing arm (022) at one end, while the other end of the third cable (032) is configured to sequentially wind from the mounting bracket (021), extend down along the

axis of the MTMP (01), and then onto a first winch (031) located at a lower portion of the MTMP (01); and, a connecting rod (023) rotatably connected to the mounting bracket (021) at one end, and slidably connected to the swing arm (022) at the other end; and,

[0011] when the third cable (032) is tightened through the first winch (031), the third cable (032) is operable to drive the swing arm (022) to rotate in a first direction, causing the rotational angle (α) to increase; and, when the third cable (032) is released, the swing arm (022) is operable to rotate under gravity effect in a second direction, causing the rotation angle (α) to decrease.

[0012] In some embodiment, the connecting rod (023) and the swing arm (022) are slidably connected through a sliding track (0231), configured to comprise: a first track end (0231a) operable to limit the rotational angle (α) to a first angle (α_1); and, a second track end (0231b) operable to limit the rotational angle (α) to a second angle (α_2).

[0013] In some embodiment, the first angle (α_1) is configured to be 90° ; and/or, the second angle (α_2) is configured to be $20^\circ\sim 30^\circ$.

[0014] In some embodiment, the mounting bracket (021) is detachably installed at the upper portion of the MTMP (01).

[0015] In some embodiment, the upper portion of the MTMP (01) is the top of the MTMP (01).

[0016] In some embodiment, the mounting bracket (021) comprises: a first pole component (0211) configured to be installed at the upper portion of the MTMP (01); and, a second pole component (0212) connected to an upper end of the first pole component (0211) and extended further away from the axis of the MTMP (01) to form a third angle (α_3) with the first pole component (0211).

[0017] In some embodiment, the swing arm (022) comprises: a third pole component (0221) and a fourth pole component (0222); the third pole component (0221) is configured to rotatably connect to a lower end of the first pole component (0211) at one end, and to fixedly connect to the fourth pole component (0222) at the other end; wherein the third pole component (0221) and the fourth pole component (0222) form a fourth angle (α_4).

[0018] In some embodiment, the swing arm (022) further comprises a fifth pole component (0223) configured to fixedly connect to both the third pole component (0221) and the fourth pole component (0222), creating a supporting triangle structure (0225) encompassing the fourth angle (α_4).

[0019] In some embodiment, both the third angle and the fourth angle are right angle.

[0020] In some embodiment, the pole system further comprises a plurality of third cable guides (033) installed along the second pole component (0212) and the axial direction of MTMP (01), and configured to guide the third cable (032) to wind from the mounting bracket (021) onto the first winch (031).

[0021] In some embodiments, the MTMP (01) comprises: a base pole (011), a fixed pole (013), and at least one telescopic pole section (012) that is slidably nested between the base pole (011) and the fixed pole (013) for adjustable extension and retraction of the MTMP (01).

[0022] In some embodiments, the base pole (011) comprises a first lifting component set, comprising a first cable (0142), a first cable guide (0144), a first locking point (0143) and a first securing point (0147); and the at least one telescopic pole section (012b) comprises a second lifting component set, comprising a second cable (0142b), a second cable guide (0144b), a second locking point (0143b), a cable track (0145b) and a second securing point (0147b); wherein the first cable (0142) is configured to fixedly connect to the first locking point (0143) of the base pole (011) at one end, while the other end of the first cable (0142) is configured to sequentially wind around the cable track (0145b) of at least one telescopic pole section (012b), the first cable guide (0144) of the base pole (011), and then onto a second winch (0141) of the base pole (011); wherein the second cable (0142b) is configured to fixedly connect to the second locking point (0143b) of the telescopic pole section (012b) at one end, while the other end of the second cable (0142b) is configured to sequentially wind around the cable track (0145a) of a corresponding adjacent upper telescopic pole section (012a), the first cable guide (0144) of the at least one telescopic pole section (012), and then onto the first securing point (0147) of the base pole (011) or the second securing point (0147b) of a corresponding adjacent lower telescopic pole section (012c).

[0023] In some embodiments, the lifting component set (014) further comprises a plurality of sliding guide pads (0148) set within gaps between adjacent telescopic pole sections (012) to facilitate smooth relative motion between the adjacent telescopic pole sections (012).

[0024] In some embodiments, the plurality of sliding guide pads (0148) is configured to be placed on the inner wall of the base pole (011), either directly at the top of the base pole (011) or at locations adjacent to the top of the base pole (011).

[0025] In some embodiments, the plurality of sliding guide pads (0148) is configured to be placed at the outer wall of the telescopic pole section (012), either directly at the bottom of the telescopic pole section (012) or at locations adjacent to the bottom of the telescopic pole section (012).

[0026] In some embodiments, the plurality of sliding guide pads (0148) is configured to be placed at the inner wall of the telescopic pole section (012), either directly at the top of the telescopic pole section (012) or at locations adjacent to the top of the telescopic pole section (012).

[0027] In some embodiments, wherein the plurality of sliding guide pads (0148) is made of abrasion-resistant high-carbon steel.

[0028] In some embodiments, the base pole (011), a fixed pole (013), and/or the telescopic pole section (012) are each coated with a thermal conductive material.

[0029] In some embodiments, a device (04) is hung onto the swing arm (022).

[0030] In some embodiments, the device is a surveillance apparatus or a lighting apparatus.

[0031] Other aspects and features of the present invention will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] In the figures, which illustrate, by way of non-limiting examples only, embodiments of the present invention,

[0033] **[Fig. 1]:** illustrates a pole system according to various embodiments of the present invention.

[0034] **[Fig. 2a]:** illustrates a pole system according to various embodiments of the present invention.

[0035] **[Fig. 2b]:** illustrates a pole system according to various embodiments of the present invention.

[0036] **[Fig. 3]:** illustrates a pole system according to various embodiments of the present invention.

[0037] **[Fig. 4]:** illustrates telescopic pole sections according to various embodiments of the present invention.

[0038] **[Fig. 5a]:** illustrates telescopic pole sections according to various embodiments of the present invention.

[0039] **[Fig. 5b]:** illustrates telescopic pole sections according to various embodiments of the present invention.

[0040] **[Fig. 6]:** illustrates telescopic pole sections according to various embodiments of the present invention.

[0041] **[Fig. 7]:** illustrates telescopic pole sections according to various embodiments of the present invention.

[0042] **[Fig. 8a]:** illustrates a cross sectional view of a telescopic pole section according to various embodiments of the present invention.

[0043] **[Fig. 8b]:** illustrates a side view of the top of a telescopic pole section according to various embodiments of the present invention.

[0044] **[Fig. 8c]:** illustrates a side view of the bottom of a telescopic pole section according to various embodiments of the present invention.

[0045] [Fig. 9]: illustrates an extension arm assembly (02) according to various embodiments of the present invention.

[0046] [Fig. 10]: illustrates an extension arm assembly (02) according to various embodiments of the present invention.

DETAILED DESCRIPTION

[0047] Throughout this document, unless otherwise indicated to the contrary, the terms “comprising”, “consisting of”, “having” and the like, are to be construed as non-exhaustive, or in other words, as meaning “including, but not limited to”.

[0048] Furthermore, throughout the document, unless the context requires otherwise, the word “include” or variations such as “includes” or “including” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0049] Unless defined otherwise, all other technical and scientific terms used herein have the same meaning as is commonly understood by a skilled person to which the subject matter herein belongs.

[0050] Embodiments of the Arm Extension Assembly (02)

[0051] According to various embodiments of the present invention, as illustrated in FIG. 1 – FIG. 3 and FIG. 9 – FIG. 10, there is provided a mast pole system, comprising a Multi-segment Telescopic Mast Pole (MTMP) (01), an extension arm assembly (02) rotatably connected to an upper portion of the MTMP (01), and an angle adjustment means (03) for adjusting rotational angle (α) of the extension arm assembly (02) relative to the axis of the MTMP (01); wherein, the extension arm assembly (02) comprises: a mounting bracket (021) installed at the upper portion of the MTMP (01), and a swing arm (022) rotatably connected to the mounting bracket (021); the angle adjustment means (03) comprises: a third cable (032) configured to attach to the swing arm (022) at one end (for example, attached through a third locking point (034) installed on the fourth pole component (0222)), while the other end of the third cable (032) is configured to sequentially wind from the mounting bracket (021), extend down along the axis of the

MTMP (01), and then onto a first winch (031) located at a lower portion of the MTMP (01); and, a connecting rod (023) rotatably connected to the mounting bracket (021) at one end, and slidably connected to the swing arm (022) at the other end; and, when the third cable (032) is tightened through the first winch (031), the third cable (032) is operable to drive the swing arm (022) to rotate in a first direction, causing the rotational angle (α) to increase; and, when the third cable (032) is released, the swing arm (022) is operable to rotate under gravity effect in a second direction, causing the rotation angle (α) to decrease.

[0052] In some embodiments, as illustrated in FIG 9, the extension arm assembly (02) includes a mounting bracket (021) designed for secure attachment to the upper section of the MTMP, typically positioned near or at the summit of the MTMP. This extension arm assembly (02) features a swing arm (022) that facilitates lateral motion (or semi-lateral motion) for any device (04) (e.g., lighting device, surveillance device) mounted onto it. Integral to this extension arm assembly (02), the angle adjustment mechanism (03) incorporates a third cable (032) that extends from the swing arm (022) to a first winch (031), with the first winch (031) positioned on the MTMP's lower segment. By adjusting the tension of the third cable (032) using the first winch (031), the rotational angle (α) of the swing arm (022) relative to the mast pole's central axis can be finely and flexibly tuned. This setup allows for relatively more precise control over the orientation of the attached devices (04), offering the flexibility to adjust their positioning as required for optimal functionality.

[0053] In some embodiments, the mast pole system is equipped with a plurality of third cable guides (033), specifically engineered to enable the third cable (032) to move smoothly to and from between the swing arm (022) and the first winch (031). This feature facilitates extending or retracting the swing arm (022), ensuring that the process of unfolding or folding is conducted efficiently and without hindrance, thereby optimizing the functionality of the swing arm's adjustments. In other words, these third cable guides (033) facilitate the smooth transition of the third cable (032), making it easier to operate the first winch (031) for adjusting the rotational angle (α) of the extension arm assembly (02). The first winch (031) could take various forms, such as manual winch, electric winch and hydraulic winch.

[0054] In some embodiments, these third cable guides (033) are positioned along

the mounting bracket (021) and follow the axial direction of the mast pole, allowing for consistent movement of the third cable (032) as the first winch (031) adjusts the tension of the third cable (032).

[0055] The third cable guides (033) can adopt different forms depending on the embodiment. For instance, the third cable guides (033) can be individual guide posts equipped with a slide track to accommodate the third cable (032); in other cases, the third cable guide (033) integrated with the mounting bracket (021) manifests as a continuous slide track carved onto or within the second pole component (0212) of the mounting bracket (021), ensuring direct and guided movement of the third cable (032) along the mounting bracket (021).

[0056] In some embodiments, the placement of the third cable guides (033) on the mounting bracket (021) should be adjusted for keeping the third cable (032) on a defined path that aligns seamlessly with the junction between the MTMP (01) and the extension arm assembly (02). This careful alignment is important for controlling the extension arm assembly (02), at least partly because the mounting bracket (021) serves as the main connector between the extension arm assembly (02) and the mast pole system (01), ensuring that the third cable's movement is properly guided. This arrangement can, at least to some extent, prevent any inadvertent deviations in the third cable's route, especially at the junction between the extension arm assembly (02) and the MTMP (01).

[0057] Additionally, the design and functionality of the third cable guides (033) positioned along the MTMP's axial direction can differ to accommodate various requirements and structural aspects of the mast pole system. For example, these guides might take the form of guide posts or a slide track that is integrated directly onto or within the MTMP, tailored to ensure efficient cable management and alignment based on the specific operational needs and architectural nuances of the mast pole system.

[0058] In some embodiments, the mounting bracket (021) comprises a first pole component (0211) that securely attaches to the mast pole at its upper portion (e.g., at or closely adjacent to the top of the mast pole). Linked to the first pole component (0211), a second pole component (0212) projects outwardly, creating a third angle (α_3) that allows for the placement of devices in positions that extend well beyond the central axis of the mast pole. In some embodiments, the third angle (α_3) formed between the first

pole component (0211) and the second pole component (0212) is a right angle (i.e., 90°).

[0059] In some embodiments, the first pole component (0211) is designed as detachably connected to the MTMP for ease of use, allowing operators to detach and reattach the arm extension assembly (02) to the mast pole as needed for device maintenance or to switch between different devices (e.g., spotlights/floodlights, military antennas, weather testing instrument, environmental test probes, mobile cameras). This detachability enhances the pole system's flexibility for a variety of applications.

[0060] In some embodiments, as illustrated in FIG 9, the swing arm (022) includes both a third pole component (0221) and a fourth pole component (0222). The third pole component (0221) is designed to establish a rotational connection at one end with the lower end of the first pole component (0211), while its other end is securely attached to the fourth pole component (0222). This configuration results in the formation of a distinct angle (α_4) between the third and fourth pole components. Beyond the role of the connecting rod (023) in bridging the mounting bracket (021) with the swing arm (022), the rotational link at the end of the third pole component (0221) introduces an additional method of securing the swing arm (022) to the mounting bracket (021). This arrangement not only ensures a more robust linkage between the stationary mounting bracket (021) and the dynamic swing arm (022) but also introduces a designated element (e.g., the third pole component (0221)) that interacts with the connecting rod (023) to enhance stability and connectivity.

[0061] For example, in some embodiments, as illustrated in FIG. 9 – FIG. 10, the mechanism by which the connecting rod (023) and the third pole component (0221) of the swing arm (022) engage involves a sliding track (0231). This sliding track (0231) is designed to feature a first track end (0231a) that defines a limit to the swing arm's rotational angle at a first angle (α_1), and a second track end (0231b) that sets a limit at a second angle (α_2). While some designs have the sliding track (0231) situated on the connecting rod (023), with a corresponding engagement feature / slider (0224) (e.g., a pin structure that is movable) on the third pole component (0221) for dynamic interaction with the sliding track (0231), it is understood in the technical field that the configuration could be inverted. That is, the sliding track (0231) could be located on the third pole component (0221), with the engagement feature/slide (0224) that slides along

this sliding track (0231) positioned on the connecting rod (023). In certain embodiments, the defined first angle (α_1) may be set at 90° , and/or the second angle (α_2) could range between 20° and 30° , offering precise control over the swing arm's positioning, between the first angle (α_1) and the second angle (α_1).

[0062] In some embodiments, the swing arm (022) is enhanced by the addition of a fifth pole component (0223), also known as a supporting rod, which is configured to establish a secure linkage with both the third pole component (0221) and the fourth pole component (0222), thereby generating a triangular support structure (0225) that defines the fourth angle (α_4). The integration of the fifth pole component (0223) is specifically aimed at bolstering the swing arm's (022) structural stability. This enhancement is helpful in some embodiments, given the swing arm's role in not only bearing devices that may exert considerable weight but also facilitating its adjustability for essential tasks like maintenance, installation, or other operational procedures. This design consideration helps the swing arm (022) maintain a balance of robust support and operational flexibility, accommodating various needs while ensuring the safety and efficiency of the mast pole system. In some embodiments, the fourth angle (α_4) formed by the third and fourth pole components is a right angle (90°).

[0063] In sum, the extension arm assembly (02) is integrated with the MTMP (01) via the mounting bracket (021), providing the capability for rotational movement around the mast pole's axis. At the core of this functionality is the angle adjustment means (03), which facilitates precise and convenient adjustment of the orientation of the extension arm assembly (02). This adjustment control is achieved through the third cable (032) that originates at the swing arm (022), runs along the MTMP's axial direction from the mounting bracket, and connects to a first winch (031) located at or near the MTMP's base pole (011). Such a configuration ensures enhanced control, allowing for fine-tuned adjustments to the swing arm's position and the rotational angle of the extension arm assembly (02). This design not only facilitates exact positioning of attached devices (04) according to their operational needs but also significantly increases the MTMP's flexibility to accommodate a variety of tasks. This versatility also makes the MTMP a suitable solution for diverse surveillance and lighting applications. Additionally, the angle adjustment means (03) simplifies the process of altering the extension arm assembly's height (e.g., the mounted device (04) can be lowered by reducing the rotational angle (α)), which, at least to some extent, could help alleviate the need for traditional height

access methods (e.g., ladders, scaffolds) for device maintenance or device replacement. Thus, the present invention allows maintenance activities to be conducted more efficiently and safely, improving accessibility for personnel and reducing the reliance on additional equipment (such as ladders, scaffolds).

[0064] Embodiments of the Lifting component set (014)

[0065] In some embodiments, as illustrated in FIG. 4 – FIG7, the height adjustment of the mast pole system could be efficiently managed by the lifting component set (014). The MTMP (01) comprises: a base pole (011) (also known as foundation pole) configured for installation into the ground or a surface; a fixed pole (013) (also known as the top pole) configured to form the uppermost portion of the MTMP (01) and support the device (04) that needs to be positioned at a height; and at least one telescopic pole section (012) (as shown in FIG. 4) that is slidably nested between the base pole (011) and the fixed pole (013) for adjustable extension and retraction of the MTMP (01) so that the overall height of the MTMP (01) can be conveniently adjusted.

[0066] Specifically, these telescopic pole sections (012) are designed as hollow pole sections, available in, for example, Round Hollow Section (RHS) and Square Hollow Section (SHS) configurations. From the base pole (011), the telescopic pole sections (012) to the fixed pole (013), these pole segments are configured with progressively smaller cross-sectional dimensions, allowing each upper segment to slidably nest within the segment directly below.

[0067] As illustrated in FIG. 4, the base pole (011) comprises a first lifting component set operable to extend and retract the at least one telescopic pole section (012), wherein the first lifting component set comprises: a first cable (0142), a first cable guide (0144), a first locking point (0143) and a first securing point (0147).

[0068] The first locking point (0143) and the first cable guide (0144) are positioned on opposite sides of the base pole (011), near or at the top portion of the base pole (011). The first locking point (0143) and the first cable guide (0144), together with the cable track (0145b), serve as anchor points that guide the movement of the first cable (0142) during the ascent and descent of at least one telescopic pole section (012). The first locking point (0143) and the first cable guide (0144), positioned near the top portion of the base pole (011), and the cable track (0145b), located at the bottom of at least one

telescopic pole section (012b), form a semi-triangular configuration. This configuration provides stable support for the elevation and downward movement of the telescopic pole sections.

[0069] The first securing point (0147) is configured to be positioned at or near the top portion of the base pole (011) to receive and secure the second cable (0142b) extended from at least one telescopic pole section (012b), positioned directly above the base pole (011).

[0070] As illustrated in FIG. 5a, the at least one telescopic pole section (012b) comprises a second lifting component set operable to extend and retract a corresponding adjacent upper telescopic pole section (012a) (or the fixed pole (013)) positioned directly above the at least one telescopic pole section (012b); wherein the second lifting component set comprises: a second cable (0142b), a second cable guide (0144b), a second locking point (0143b), a cable track (0145b) and a second securing point (0147b). The second locking point (0143b) and the second cable guide (0144b) are positioned on opposite sides of the at least one telescopic pole section (012b), near or at the top portion of the at least one telescopic pole section (012b), serving as anchor points that guide the movement of the second cable (0142b) during the ascent and descent of the at least one telescopic pole section (012). These anchor points also form a semi-triangular configuration, providing support for the elevation and downward movement of the telescopic pole sections.

[0071] The cable track (0145b) is set at or adjacent to the bottom of the at least one telescopic pole section (012b), configured to guide the movement of the first cable (0142) from the base pole (011), which is positioned directly below the at least one telescopic pole section (012b).

[0072] In some embodiments, the first cable (0142) is configured to fixedly connect to the first locking point (0143) of the base pole (011) at one end, while the other end of the first cable (0142) is configured to sequentially wind around the cable track (0145b) of the at least one telescopic pole section (012b) located directly above the base pole (011), the first cable guide (0144) of the base pole (011), and then onto a second winch (0141) positioned on the outer surface of the base pole (011) at a height conveniently for the user to operate the ascent and descent of the MTMP (01).

[0073] Similarly, the second cable (0142b) is configured to fixedly connect to the second locking point (0143b) of the at least one telescopic pole section (012b) at one end, while the other end of the second cable (0142b) is configured to sequentially wind around the cable track (0145a) of the at least one telescopic pole section (012a) positioned directly above the at least one telescopic pole section (012b), the second cable guide (0144b) of the at least one telescopic pole section (012b), and then onto a first securing point (0147) of the base pole (011).

[0074] As illustrated in FIG. 5b, in some embodiments, there are at least three telescopic pole sections stacked together: a telescopic pole section (012b) (i.e., first telescopic pole section), a corresponding adjacent upper telescopic pole section (012a) (i.e., second telescopic pole section) positioned directly above the telescopic pole section (012b) and a corresponding adjacent lower telescopic pole section (012c) (i.e., third telescopic pole section) positioned directly below the telescopic pole section (012b). These telescopic pole sections (012) are configured with progressively smaller cross-sectional dimensions, allowing the telescopic pole section (012b) slidably nested inside the corresponding adjacent lower telescopic pole section (012c), and the corresponding adjacent upper telescopic pole section (012a) slidably nested inside the telescopic pole section (012b).

[0075] As illustrated in FIG. 5b, each telescopic pole section (012) comprises a second locking point (0143a, 0143b, 0143c), a second cable guide (0144a, 0144b, 0144c), a cable track (0145a, 0145b), and a second securing point (0147a, 0147b, 0147c). The second locking point and second cable guide are positioned on opposite sides, near or at the top portion of each telescopic pole section (012). The cable track is installed at the bottom of each telescopic pole section (012). The second securing point is located near or at the top portion of each telescopic pole section (012). In some embodiments, the second locking point and second securing point of each telescopic pole section, along with the first locking point and first securing point of the base pole, are designed as an integrated component. This configuration facilitates proper alignment of the first and second cables during the ascent and descent of the telescopic pole sections (012) and facilitates the even distribution of forces across the telescopic pole sections and the base pole, which further improves the overall stability of the MTMP during operation.

[0076] To ascend or descend the corresponding adjacent upper telescopic pole section (012a) from the telescopic pole section (012b), a second cable (0142b) is configured to fixedly connect to the second locking point (0143b) of the telescopic pole section (012b) at one end, while the other end of the second cable (0142b) is configured to sequentially wind around the cable track (0145a) of the at least one telescopic pole section (012a) positioned directly above the at least one telescopic pole section (012b), the second cable guide (0144b) of the at least one telescopic pole section (012b), and then onto a second securing point (0147) of the corresponding adjacent lower telescopic pole section (012c).

[0077] As illustrated in FIG. 6 and FIG. 7, the elevation process for the Multi-segment Telescopic Mast Pole (MTMP) (01) is initiated by the second winch (0141) (e.g., manual winch, electric winch and hydraulic winch), which coils the first cable (0142) around its drum, creating a downward pull. This downward pull routes the first cable (0142) in a specific order: beginning from the first cable guide (0144) at the top portion of the base pole (011), through one or more cable tracks (0145b) situated at the bottom of a telescopic pole section (12b) that is positioned inside and directly above the hollow base pole (011), and finally applying tension at the first locking point (0143) located on the opposite side from the first cable guide (0144) at or near the top portion of the base pole (011). This configuration exerts an upward force on the bottom of the telescopic pole section (012b), causing it to ascend and extend upward from the base pole (011), thereby increasing the mast pole's height. When the MTMP (01) needs to be lowered down, the second winch (0141) can then be unwound to release the tension on the first cable (0142), allowing the telescopic pole section (012b) above the base pole (011) to descend in to the base pole (011) due to the gravitational force.

[0078] In addition, among the telescopic pole sections (012) stacked between the base pole (011) and the fixed pole (013), the second lifting component set further comprises a second cable (0142b) configured to fixedly connect to the second locking point (0143b) of the telescopic pole section (012) at one end, while the other end of the second cable (0142b) is configured to sequentially wind around the cable track (0145a) of the corresponding adjacent upper telescopic pole section (012a), the second cable guide (0144b) of the telescopic pole section (012), and then onto the first securing point (0147) of the base pole (011) or the second securing point (0147c) of a corresponding adjacent lower telescopic pole section (012c).

[0079] As illustrated in FIG. 6 and FIG. 7, as the first telescopic pole (012b) commences its upward movement, the interval between the upper end of the first telescopic pole section (012b) and the top of the base pole (011) widens. This process unfolds in a manner similar to the previously outlined operation that lifts up the first telescopic pole section (012b). Similar to the first cable (0142) wound onto the various components at base pole (011), the second cable (0142b) extends from the second locking point (0143b) of the first telescopic pole section (012b), navigates through the cable tracks (0145a) located at the lower end of the subsequent telescopic pole (i.e., the second telescopic pole (012a)) inside and directly above the first telescopic pole (012b), ascends passing through the second cable guide (0144b) on the top of the first telescopic pole (012b), and eventually secures at the first securing point (0147) positioned at the top of the base pole (011). This configuration results in an expanded gap between the peak of the first telescopic pole (012b) and the base pole (011), effectively elongating the portion of the second cable (0142b) caught between the first securing point (0147) at the top of the base pole (011) and the second cable guide (0144b) at the top of the first telescopic pole (012b). Accordingly, this results in a shortening of the second cable (0142b) span between the second cable guide (0144b) and the second locking point (0143b) inside the hollow structure of the first telescopic pole (012b), exerting an upward force on the lower end of the second telescopic pole (012a) (e.g., through the cable track (0145a)). Consequently, the second telescopic pole (012a) is prompted to rise and extend from within the first telescopic pole (012b), in coordination with the ascent of the first telescopic pole (012b).

[0080] Likewise, for additional telescopic pole sections that are staged or stacked above the second telescopic pole (012a), the ascent of the second telescopic pole (012a) initiates the upward movement of these subsequent telescopic pole sections. This domino effect ensures a seamless and coordinated extension of the entire structure. Thus, the invention facilitates a synchronized height adjustment across all telescopic sections during operation, achieving a harmonious and efficient elevation process.

[0081] In some embodiments, when the mast pole system needs to be lowered, the second winch (0141) is unwound to release tension on the first cable (0142). This process inversely mirrors the elevation sequence, allowing the telescopic pole sections to retract sequentially from top to bottom, ultimately into the base pole, in a controlled

manner. As the winch releases the first cable (0142), gravitational force facilitates the descent of the uppermost telescopic pole section into the telescopic pole section positioned directly below it. This retraction continues step-by-step, with each telescopic pole section sliding smoothly into the preceding compartment.

[0082] The coordinated retraction of the telescopic pole sections is guided by the same cable guides (e.g., the first cable guide (0144), second cable guide (0144b), and cable track (0145)) and cable system (e.g., the first cable (0142) and second cable (0142b)) that facilitated their ascent. This configuration facilitates smooth movement and minimizes the risk of cable tangling or misalignment, as only a single cable is configured to connect each pair of adjacent telescopic pole sections (012) as well as the base pole (011), mitigating the risk of accidental cable tangling. Additionally, the downward movement is carefully regulated by the tension managed through the second winch (0141) as well as the first and second cables, preventing sudden drops that could damage the system or create safety hazards.

[0083] As described above, each cable sequentially passes through the locking points (e.g., the first locking point (0143) and the second locking point), the cable track located at the bottom of the telescopic section, and the cable guides (e.g., the first cable guide (0144) and the second cable guide (0144b)), forming a triangular or semi-triangular configuration, which also facilitates stabilizing the movements of the telescopic pole sections during the elevation and retraction processes.

[0084] The movement of each telescopic pole section is further stabilized by securing the corresponding cable of the telescopic pole section to a securing point positioned on the adjacent lower telescopic pole section, or to a securing point on the base pole when the telescopic pole section is directly above the base pole. In this configuration, all telescopic pole sections and the base pole are mechanically linked through the cables, which could facilitate the sequential movement of the telescopic pole sections. As a result, the movement occurs in a more coherent, controlled, and synchronized manner, enhancing the overall stability and reliability of the telescopic pole system during the elevation and retraction processes. In some embodiments, the securing point and the cable guide are integrated into a single component within each telescopic pole section or the base pole. This integration could help facilitate alignment of the cables between the cable guide of the telescopic pole section positioned above

and the securing point of the telescopic pole section positioned below, thereby further improving the stability of the MTMP during the ascent and descent processes.

[0085] As each telescopic pole section (012) descends, the mast pole system's overall height decreases until all telescopic pole sections are completely retracted into the base pole (011), returning the system to its initial, compact form. Alternatively, should there be a requirement to adjust the mast pole system to a new, reduced height rather than fully collapse it, only part of the first telescopic pole section (012b) would need to be retracted into the base pole (011). This flexibility allows for more flexible and precise height customization, catering to specific operational needs or environmental conditions without necessitating the complete retraction of the system. Overall, clear to any skilled artisan in the field, this controlled lowering process emphasizes the pole system's adaptability and precision, allowing for safe, efficient adjustments to the mast pole's height in response to operational requirements or environmental conditions.

[0086] In some embodiments of the invention, the MTMP (01) comprises a plurality of sliding guide pads (0148) designed to enhance the stability of both the extension and retraction of the telescopic pole sections (012). These sliding guide pads (0148) are positioned within the spaces between adjacent pole sections. The dimensions of each sliding guide pad (0148) are configured to occupy the space between the inner wall of a lower telescopic pole section (e.g., the first telescopic pole section (012b)) and the outer wall of the upper telescopic pole section directly above it (e.g., the second telescopic pole section (012a)), or between the inner wall of the base pole (011) and the outer wall of the first telescopic pole section (012b). The integration of these sliding guide pads (0148) establishes stable contact surfaces between adjacent telescopic pole sections and the base pole, preventing shaking, tilting, or misalignment during ascent and descent. Furthermore, the sliding guide pads (0148) generate controlled frictional forces that counterbalance the loads exerted by the upper telescopic sections on the cables during the descending process and prevent sudden upward movements of the telescopic pole sections caused by excessive pulling forces during the ascending process. This friction also helps to reduce wear and extend the durability of the MTMP. By maintaining proper alignment and structural stability, this configuration helps achieve smooth, controlled movements between pole sections (e.g., base pole and telescopic pole sections) during operational adjustments, thereby promoting seamless transitions and maintaining the structural cohesion of the system.

[0087] In various embodiments, the sliding guide pads (0148) are designed to be positioned on the inner wall of the base pole (011), either directly at the top of the base pole (011) or in areas close to the top or in other areas of the base pole (011). Similarly, the sliding guide pads (0148) can be installed on the outer wall of the telescopic pole section (012), placed at the bottom or near the bottom of the telescopic section (012). Additionally, in some embodiments, there is provision for mounting the sliding guide pads (0148) on the inner wall of the telescopic pole section (012), either at the very top of the section or in regions adjacent to the top or in other regions on the inner wall of the telescopic pole section (012). This placement flexibility of the sliding guide pads (0148) ensures efficient movement and a tight fit between telescopic sections, facilitating their smooth extension and retraction within the mast pole system.

[0088] In some embodiments, in order to enhance the mast pole system's durability, these sliding guide pads (0148) are made of wear-resistance material that surpasses the endurance of the pole material itself. Specifically, these sliding guide pads (0148) are crafted from abrasion-resistant high-carbon steel, a material chosen for its wear resistance relative to the standard steel typically employed in fabricating the pole sections. This arrangement helps improve the mast pole system's longevity and reliability: the sliding guide pads (0148), being in perpetual contact with the pole section's internal surfaces, demand a material robust enough to endure constant friction without significant wear over time. Conversely, the pole's internal surfaces contact the guide pads only at discrete points. Therefore, wear on the pole section is confined to these specific contact areas, not affecting the entirety of the pole. Utilizing a material with enhanced wear resistance, like high-carbon, abrasion-resistant alloy steel for the guide pads (0148), could help improve mast pole system's durability. This approach effectively addresses a common technical issue in conventional telescopic mast pole systems, where repeated relative motion between pole sections accelerates wear. By employing abrasion-resistant materials, these sliding guide pads (0148) can withstand the ongoing friction from the sliding movements of the pole sections, which is essential for the system's smooth and stable functionality over time. This setup underscores the importance of wear reduction and stability enhancement in frequently moved components of the mast pole system. Therefore, the placement of these sliding guide pads (0148) facilitates seamless and precise interactions between the telescopic pole sections. These sliding guide pads (0148) not only boosts the system's mechanical

performance (i.e., extension and retraction of the telescopic pole sections) but also upholds its structural integrity through extended periods of operation, thereby ensuring efficient and reliable functioning of the mast pole system.

[0089] The sliding guide pads (0148) in various embodiments can exhibit a diversity of configurations, extending from long pad forms to circular disc shapes, interlocking designs, or even segmented strips. Each of these structures is tailored to facilitate seamless movement between the telescopic pole sections while simultaneously ensuring a snug and secure fit, essential for maintaining the structural integrity and operational stability of the mast pole system.

[0090] In summary, as described above, the present invention addresses the technical problems in the conventional arts by introducing a foldable extension arm assembly (02) at the top of the telescopic mast pole (MTMP) (01), allowing surveillance devices or lighting fixtures (04) to be positioned directly above the target boundary (05) (e.g., a security fence). This ensures the target monitoring area or illumination direction falls within the surveillance or lighting coverage, significantly reducing the distance between the telescopic mast pole (MTMP) (01) and the target boundary (05). On the other hand, because the extension arm assembly (02) can rotate within a vertical plane, it drives the surveillance equipment or lighting devices (04) to move up and down within the vertical plane, enhancing flexibility on uneven ground and across boundaries of varying heights.

[0091] Further, by placing sliding guide pads (0148) between the sliding inner and outer pole components (011, 012, 013), the contact area during sliding is significantly reduced, thus extending the lifespan of the pole components (011, 012, 013). This innovation not only offers a solution to the limitations presented by uneven terrain and fixed monitoring or lighting requirements but also introduces a versatile and durable system capable of accommodating various installation environments. The telescopic mast pole (MTMP) (01) with its foldable extension arm assembly (02) and enhanced sliding mechanism represents a significant advancement in the field, providing more efficient, flexible, and durable options for surveillance and lighting installations.

[0092] In practical use, the lifting component sets (014) (e.g., the first lifting component and the second lifting component) and the arm extension assembly (02) of the present invention can be utilized synergistically together to facilitate the convenient

installation, operation, and maintenance of the MTMP (01). For instance, during installation, the lifting component sets (014) enable the telescopic pole sections to be safely and smoothly elevated to the desired height without fully extending the device to its ultimate position. Once the appropriate height is achieved, the arm extension assembly (02) can then be operated to extend the device to its intended final position.

[0093] During operation, maintenance or replacement tasks can be easily performed by retracting the arm extension assembly (02) to lower the device to a height that allows for easier access. Even if the initial lowered height is not optimal for certain circumstances due to the limitation of the arm extension assembly (02), the lifting component sets (014) can be utilized to precisely and safely adjust the overall height of the telescopic pole system. This configuration helps the maintenance and replacement work to be carried out conveniently, efficiently, and with enhanced safety.

[0094] It should be further appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments falling within the intended scope of the invention.

[0095] As would be understood by a person skilled in the art, each embodiment may be used in combination with other embodiment or several embodiments.

REFERENCE

01 Multi-segment Telescopic Mast Pole (MTMP)

011 Base pole

012 Telescopic pole section

012a Second telescopic pole section

012b First telescopic pole section

012c Third telescopic pole section

013 Fixed pole

014 Lifting component set

0141 Second winch

0142 First cable

0142b Second cable

0143 First locking point

0143a/0143b/0143c Second locking point

0144 First cable guide

0144a/0144b/0144c Second cable guide

0145/0145a/0145b Cable track

0147 First securing point

0147a/0147b/0147c Second securing point

0148 Sliding guide pad

02 Extension arm assembly

021 Mounting bracket

0211 First pole component

0212 Second pole component

022 Swing arm

0221 Third pole component

0222 Fourth pole component

0223 fifth pole component

0224 Slider

0225 supporting triangle structure

023 Connecting rod

0231 Sliding track

0231a first track end

0231b second track end

03 Angle adjustment means

031 First winch

032 Third cable

033/033a/033b Third cable guide

034 Third locking point

04 Device

05 Boundary

Claims

Claim 1. A pole system, comprising a Multi-segment Telescopic Mast Pole (MTMP) (01), an extension arm assembly (02) rotatably connected to an upper portion of the MTMP (01), and an angle adjustment means (03) for adjusting rotational angle (α) of the extension arm assembly (02) relative to the axis of the MTMP (01); wherein, the extension arm assembly (02) comprises:

a mounting bracket (021) installed at the upper portion of the MTMP (01), and
a swing arm (022) rotatably connected to the mounting bracket (021);

the angle adjustment means (03) comprises:

a third cable (032) configured to attach to the swing arm (022) at one end, while the other end of the third cable (032) is configured to sequentially wind from the mounting bracket (021), extend down along the axis of the MTMP (01), and then onto a first winch (031) located at a lower portion of the MTMP (01); and,
a connecting rod (023) rotatably connected to the mounting bracket (021) at one end, and slidably connected to the swing arm (022) at the other end; and,

when the third cable (032) is tightened through the first winch (031), the third cable (032) is operable to drive the swing arm (022) to rotate in a first direction, causing the rotational angle (α) to increase; and,

when the third cable (032) is released, the swing arm (022) is operable to rotate under gravity effect in a second direction, causing the rotation angle (α) to decrease.

Claim 2. The pole system according to Claim 1, wherein the connecting rod (023) and the swing arm (022) are slidably connected through a sliding track (0231), configured to comprise:

a first track end (0231a) operable to limit the rotational angle (α) to a first angle (α_1); and, a second track end (0231b) operable to limit the rotational angle (α) to a second angle (α_2).

Claim 3. The pole system according to Claim 2, wherein the first angle (α_1) is configured to be 90° ; and/or, the second angle (α_2) is configured to be $20^\circ\sim 30^\circ$.

Claim 4. The pole system according to any one of Claims 1 – 3, wherein the mounting bracket (021) is detachably installed at the upper portion of the MTMP (01).

Claim 5. The pole system according to Claim 4, wherein the upper portion of the MTMP (01) is the top of the MTMP (01).

Claim 6. The pole system according to any one of Claims 1, wherein the mounting bracket (021) comprises:

a first pole component (0211) configured to be installed at the upper portion of the MTMP (01); and,

a second pole component (0212) connected to an upper end of the first pole component (0211) and extended further away from the axis of the MTMP(01) to form a third angle (α_3) with the first pole component (0211).

Claim 7. The pole system according to Claim 6, wherein the swing arm (022) comprises:

a third pole component (0221) and a fourth pole component (0222);

the third pole component (0221) is configured to rotatably connect to a lower end of the first pole component (0211) at one end, and to fixedly connect to the fourth pole component (0222) at the other end;

wherein the third pole component (0221) and the fourth pole component (0222) form a fourth angle (α_4).

Claim 8. The pole system according to Claim 7, wherein the swing arm (022) further comprises a fifth pole component (0223) configured to fixedly connect to both the third pole component (0221) and the fourth pole component (0222), creating a supporting triangle structure (0225) encompassing the fourth angle (α_4).

Claim 9. The pole system according to Claim 7, wherein both the third angle and the fourth angle are right angle.

Claim 10. The pole system according to Claim 1, comprising a plurality of third cable guides (033) installed along the second pole component (0212) and the axial direction of MTMP (01), and configured to guide the third cable (032) to wind from the mounting bracket (021) onto the first winch (031).

Claim 11. The pole system according to Claim 1, wherein the MTMP (01) comprises: a base pole (011), a fixed pole (013), and at least one telescopic pole section (012) that is slidably nested between the base pole (011) and the fixed pole (013) for adjustable extension and retraction of the MTMP (01).

Claim 12. The pole system according to Claim 11, further comprising:

the base pole (011) comprises a first lifting component set, comprising a first cable (0142), a first cable guide (0144), a first locking point (0143) and a first securing point (0147); and,

the at least one telescopic pole section (012b) comprises a second lifting component set, comprising a second cable (0142b), a second cable guide (0144b), a second locking point (0143b), a cable track (0145b) and a second securing point (0147b);

wherein the first cable (0142) is configured to fixedly connect to the first locking point (0143) of the base pole (011) at one end, while the other end of the first cable (0142) is configured to sequentially wind around the cable track (0145b) of at least one telescopic pole section (012b) positioned directly above the base pole (011), the first cable guide (0144) of the base pole (011), and then onto a second winch (0141) of the base pole (011); and,

wherein the second cable (0142b) is configured to fixedly connect to the second locking point (0143b) of the at least one telescopic pole section (012b) at one end, while the other end of the second cable (0142b) is configured to sequentially wind around the cable track (0145a) of a corresponding adjacent upper telescopic pole section (012a), the first cable guide (0144) of the at least one telescopic pole section (012), and then onto the first securing point (0147) of the base pole (011) or the second securing point (0147b) of a corresponding adjacent lower telescopic pole section (012c).

Claim 13. The pole system according to Claim 12, wherein the lifting component set (014) further comprises a plurality of sliding guide pads (0148) set within gaps between adjacent telescopic pole sections (012) to facilitate smooth relative motion between the adjacent telescopic pole sections (012).

Claim 14. The pole system according to Claim 13, wherein the plurality of sliding guide pads (0148) is configured to be placed on the inner wall of the base pole (011), either directly at the top of the base pole (011) or at locations adjacent to the top of the base pole (011).

Claim 15. The pole system according to Claim 13, wherein the plurality of sliding guide pads (0148) is configured to be placed at the outer wall of the telescopic pole section (012), either directly at the bottom of the telescopic pole section (012) or at locations adjacent to the bottom of the telescopic pole section (012).

Claim 16. The pole system according to Claim 13, wherein the plurality of sliding guide pads (0148) is configured to be placed at the inner wall of the telescopic pole section (012), either directly at the top of the telescopic pole section (012) or at locations adjacent to the top of the telescopic pole section (012).

Claim 17. The pole system according to any one of Claims 13 – 16, wherein the plurality of sliding guide pads (0148) is made of abrasion-resistant high-carbon steel.

Claim 18. The pole system according to any one of Claims 11 – 17, wherein the base pole (011), a fixed pole (013), and/or the telescopic pole section (012) are each coated with a thermal conductive material.

Claim 19. The pole system according to any one of Claims 11 – 18, wherein a device (04) is hung onto the swing arm (022).

Claim 20. The pole system according to Claim 19, wherein the device is a surveillance apparatus or a lighting apparatus.