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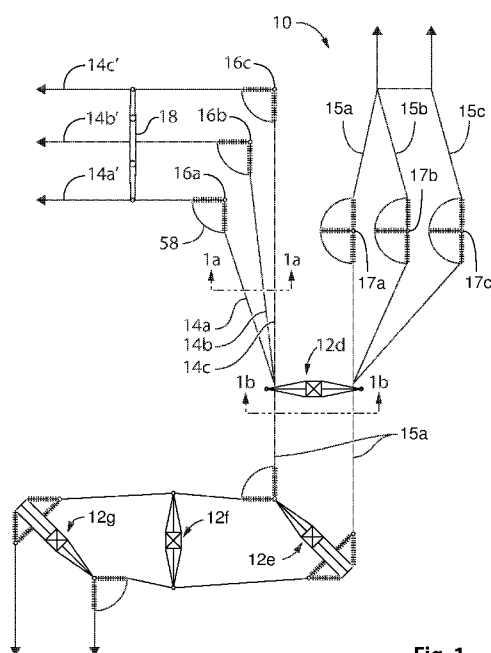


Fig. 1

(57) Abstract: A method of using a temporary conductor as a re-usable tool in maintaining, repairing or re-conductoring at least one energized phase, includes stringing the temporary conductor between support structures at either end of a first section, then energizing the said temporary conductor by bringing the temporary conductor to the voltage potential of the phase and electrically paralleling the temporary conductor with the energized phase, de-energizing and then maintaining, repairing or re-conductoring the de-energized energized phase, re-energizing and electrically paralleling said energized phase, de-energizing and removing the temporary conductor for later re-use as the re-usable tool in a second section of the energized phase.

CONDUCTOR AS A TOOL

Field of the Invention

This invention relates to the field of repair or re-conductoring of energized conductors and to the use and re-use of temporary conductors in the manner of a tool which is used over and over again as work progresses from section to section along energized power lines.

Summary of the Invention

A method of using a piece of conductor as a tool, wherein the method is for use in live re-conductoring of energized phases, at a voltage potential, strung, in at least a first section, between at least first and second supports, and also in a contiguous second section, contiguous to the first section, between the second and a third support,

wherein in both the first and second sections of the energized phases or conductors are contiguous between the first and second sections,

and wherein the energized phases or conductors comprise a spaced apart energized array of energized conductors, which may be substantially parallel, and which may be vertically or horizontally aligned vertically spaced apart energized array of energized conductors, wherein the energized conductors comprise separate phases,

the method comprising in the first section:

- a) providing a re-usable set of temporary conductors,
- b) stringing the temporary conductors in a substantially aligned, spaced apart temporary array alongside, and spaced apart from, the energized array so that each energized conductor of the energized array has a corresponding temporary conductor of the temporary array alongside it,
- c) commencing with a first energized conductor of the energized array, energizing so as to bring a corresponding first temporary conductor of the temporary array to the voltage potential of the first energized conductor, paralleling the first temporary conductor with the first energized conductor, and then de-energizing the first conductor,

- d) maintaining, for example, repairing or re-conductoring, the de-energized first conductor or delaying the maintenance,
- e) repeating in sequence steps (a) through (d) for each subsequent energized conductor in the energized array and corresponding temporary conductor in the temporary array,
- f) for those energized conductors not maintained in step (d), then maintaining those energized conductors, then,
- g) re-energizing the conductors and paralleling the energized conductors with the temporary conductors,
- h) de-energizing the temporary conductors,
- i) removing the temporary conductors for later re-use as a tool in the second section,

the method further comprising in the second section:

- j) providing the set of temporary conductors,
- k) repeating steps (b) through (i), whereby the maintenance on the first and second sections occurs without transposing relative positions of the energized conductors in the energized array, and whereby the temporary conductors are re-usable from section to section.

The invention is an apparatus, system and/or method as shown, described or implied herein.

Brief Description of the Drawings

In the drawings wherein like reference characters denote corresponding parts in each view; and wherein the procedure described in Figures 1-20 apply to a first of three phases and are illustrated by way of example as applied to the top phase in a vertical array of three phases: namely, a top phase, a center phase, and a bottom phase:

Figure 1 is in diagrammatic plan view the layout of the energized conductors, re-conductoring.

Figure 1a is a sectional view partially cut away along line 1a-1a on Figure 1.

Figure 1b is a partially cut away sectional view along line 1b-1b on Figure 1.

Figure 2 is the plan view of Figure 1 showing the addition of a temporary line.

Figure 2a is a sectional view in Figure 2 at the position shown at Figure 1a in Figure 1.

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Figure 2b is a sectional view in Figure 2 at the position of sectional view Figure 1b in Figure 1.

Figure 3 is the view of Figure 2 showing an installed jumper.

Figure 3a is a sectional view of Figure 3 in the position of sectional view of Figure 2a in Figure 2.

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Figure 3b is a sectional view in Figure 3 at the position of sectional view of Figure 2b in Figure 2.

Figure 4 is the view of Figure 3 showing the installation of a further jumper.

Figure 4a is a sectional view at the position of sectional view of Figure 3a.

Figure 4b is a sectional view at the position of sectional view of Figure 3b.

Figure 5 is the view of Figure 4 showing the installation of a further jumper.

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Figure 5a is a sectional view at Figure 5 at the position of the sectional view of Figure 4a in Figure 4.

Figure 6a is a sectional view of Figure 6 in the position of Figure 5a in Figure 5.

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Figure 7 is the view of Figure 6 showing the addition of a first temporary polymer post and transfer bus breaker.

Figure 7a is a sectional view in Figure 7 at the position of the sectional view of Figure 6a in Figure 6.

Figure 7b is a sectional view along line 7b-7b in Figure 7.

Figure 7c is a sectional view along line 7c-7c in Figure 7.

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Figure 8 is the view of Figure 7 showing the installation of two further jumpers.

Figure 8a is a sectional view in Figure 8 at the position of the sectional view of Figure 7a in Figure 7.

Figure 8b is a sectional view in Figure 8 at the position of a sectional view Of Figure 7b in Figure 7.

5 Figure 8c is a sectional view in Figure 8 at the position of a sectional view of Figure 7c in Figure 7.

Figure 9 is the view of Figure 8 showing the installation of a second or further temporary breaker, polymer posts, and a transfer buses one on each side.

10 Figure 9a is a sectional view in Figure 9 at the position of the sectional view of Figure 8a in Figure 8.

Figure 9b is a sectional view in Figure 9 at the position of the sectional view of Figure 8b in Figure 8.

Figure 9C is a sectional view in Figure 9 at the position of the sectional view of Figure 8c in Figure 8.

15 Figure 10 is the view of Figure 9 showing the installation of a further two jumpers.

Figure 10a is a sectional view in Figure 10 at the position of a sectional view of Figure 9a in Figure 9.

20 Figure 10b is a sectional view in Figure 10 at the position of the sectional view of Figure 9b in Figure 9.

Figure 10c is a sectional view in Figure 10 at the position of the sectional view of Figure 9c in Figure 9.

Figure 11 is the view of Figure 10 showing the installation of a temporary jumper to a suspension insulator.

25 Figure 11a is a sectional view in Figure 11 at the position of the sectional view of Figure 10a in Figure 10.

Figure 11b is a sectional view in Figure 11 at the position of the sectional view of Figure 10b in Figure 10.

Figure 12 the view of Figure 11 showing the first temporary breaker closed.

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Figure 12a is a sectional view in Figure 12 at the position of the sectional view of Figure 11a in Figure 11.

Figure 12b is a sectional view in Figure 12 at the position of the sectional view of Figure 11b in Figure 11.

Figure 12c is a sectional view in Figure 12 at the position of the sectional view of Figure 10c at Figure 10.

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Figure 13 is the view of Figure 12 showing the closing of the second or further temporary breaker.

Figure 13a is a sectional view in Figure 13 at the position of a sectional view of Figure 12a in Figure 12.

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Figure 13b is a sectional view in Figure 13 at the position of a sectional view of Figure 12b in Figure 12.

Figure 14 is the view of Figure 13 showing the installation of a further jumper.

Figure 14a is a sectional view in Figure 14 at the location of the sectional view of Figure 13a in Figure 13.

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Figure 14b is a sectional view in Figure 14 at the position of the sectional view of Figure 13b in Figure 13.

Figure 15 is the view of Figure 14 showing the removal of a permanent jumper.

Figure 15a is a sectional view in Figure 15 at the position of a sectional view of Figure 14a in Figure 14.

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Figure 15b is a sectional view in Figure 15 at the position of the sectional view of Figure 14b in Figure 14.

Figure 16 is the view of Figure 15 showing the installation of a further jumper.

Figure 16a is a sectional view in Figure 16 at the position of the sectional view of Figure 15a in Figure 15.

Figure 16b is a sectional view in Figure 16 at the position of the sectional view of Figure 15b in Figure 15.

5 Figure 17 is the view of Figure 16 showing the removal of a permanent jumper.

Figure 17a is a sectional view in Figure 17 in the position of the sectional view of Figure 16a in Figure 16.

10 Figure 17b is a sectional view of Figure 17 at the position of the sectional view of Figure 16b in Figure 16.

Figure 18 is the view of Figure 17 showing the opening of the second breaker.

Figure 18a is a sectional view in Figure 18 at the position of the sectional of Figure 17a in Figure 17.

15 Figure 18b is a sectional view in Figure 18 at the position of the sectional of Figure 17b in Figure 17.

Figure 19 the view of Figure 18 showing the opening of the first breaker.

Figure 19a is a sectional view in Figure 19 at the position of the sectional view of Figure 18a in Figure 18.

20 Figure 19b is a sectional view in Figure 19 at the position of the sectional view of Figure 18b in Figure 18.

Figure 19c is a sectional view in Figure 19 at the position of the sectional view of Figure 12c in Figure 12.

Figure 20 is the view of Figure 19 showing the removal of jumpers.

25 Figure 20a is a sectional view in Figure 20 at the position of the sectional view of Figure 19a in Figure 19.

Figure 20b is a sectional view in Figure 20 at the position of the sectional view of Figure 19b in Figure 19.

Figure 20c is a sectional view in Figure 20 at the position of the sectional view of Figure 19c in Figure 19.

Figures 21–31 reproduce the procedure illustrated in the step-by-step breakdown in Figures 1–20 wherein the procedure of Figures 1-20 are applied to a top phase, and the procedure of Figures 21-31 are applied to the center phase.

Figures 32-42 apply the procedure of Figures 21-31 to the bottom phase wherein the steps in corresponding views are substantially the same steps applied to the bottom phase as have been applied to the center phase.

Figure 43 shows, in side and elevation views, a support structure supporting top, center, and bottom phases, and a pair of temporary transfer buses extending vertically up the support structure from a circuit breaker.

Figure 44a is a front elevation view of an H-frame support structure carrying three phases in a horizontal configuration suspended from a cross-arm.

Figure 44b is the view of Figure 44a showing a temporary support post mounted to the H-frame.

Figure 45 is the view of Figure 44b showing a temporary conductor installed and suspended from the temporary support post.

Figure 46 is the view of Figure 45 showing the A phase load being transferred to the temporary conductor.

Figure 47 is the view of Figure 46 illustrating that the new D phase is reconductored once the A phase load has been transferred to the temporary conductor.

Figure 48 is the view of Figure 47 showing the B phase load being transferred to the conductor which was reconductored in Figure 47.

Figure 49 is the view of Figure 48 illustrating that the new D phase is reconductored once the B phase load has been transferred to the conductor which was reconductored in Figure 47.

Figure 50 is the view of Figure 49 showing the C phase load being transferred to the conductor which was reconductored in Figure 49.

Figure 51 is the view of Figure 50 illustrating that the new D phase is reconductored once the C phase load has been transferred to the conductor which was reconductored in Figure 49.

Figure 52 is the view of Figure 51 showing the C phase load being transferred back to the reconductored C phase.

Figure 53 is the view of Figure 52 showing the B phase load being transferred back to the reconductored B phase.

Figure 54 is the view of Figure 53 showing the A phase load being transferred back to the reconductored A phase.

Figure 55 is the view of Figure 54 showing the temporary conductor removed.

Figure 56 is the view of Figure 55 showing the temporary support post removed.

Figure 57 is the view of Figure 56 showing a temporary conductor suspended from the H-frame cross arm under a pair of insulators which form a V-shape.

Detailed Description of Preferred Embodiments

With reference to Figure 1, what is seen is the layout of support towers, and of the conductors supported by the towers, as seen from above, that is, in plan view.

Figure 1a is a side elevation view along line 1a-1a in Figure 1. Figure 1b is a side elevation view along line 1b-1b in Figure 1. A compass orientation is provided in each view for ease of reference between the various labelled phases. The orientation of the compass is by way of example only.

Thus, as seen in the diagrammatic overview 10, which is intended to be representative and not limiting, each of support towers 12d, 12e, 12f, and 12g support, on either side of each tower, electrical conductors comprised of three phases; namely, top phase 14a, center phase 14b, and bottom phase 14c. In the illustrated example the main line being reconductored is 345 Kilovolts (KV) and the circuit on the right is 138 KV as indicated by shorter insulators, the 138 KV line

phases are identified using reference numbers 15a, 15b and 15c. Poles are identified as 17a, 17b and 17c and are only shown in figure 1. This embodiment is not intended to be limiting as other high voltage loads may also be carried. In the lower portion of Figure 1, because phases of 14a-14c are stacked vertically one above the other as seen in Figure 1b, only top phase 14a can be seen. In the upper portion of Figure 1a, that is in the upper portion of Figure 1 relative to structure 16, each of the phases diverges in plan view from one another so as to convert from a vertical spaced apart array of phases to a horizontally spaced apart horizontal array of phases 14a-14c carried by vertical supports 16a-16c respectively. The horizontal array of phases 14a-14c is then carried on support structure 18.

As carried by support structure 18, top phase 14a is renumbered as horizontal phase 14a. Likewise, center phase 14b is relabeled as horizontal phase 14b' and bottom phase 14c is relabeled horizontal phase 14c.

The energized re-conductoring method according to one aspect of the present invention is exemplified by the illustrated operations carried out on the layout of Figure 1 as shown in the balance of the Figures 2-42, as those operations are described below. One skilled in the art would know that such operations in a live re-conductoring exercise are highly dangerous and that safety precautions must be followed, so as to avoid hazards such as for example, those discussed in US patent number 7,535,132 entitled Live Conductor Stringing and Splicing Method and Apparatus.

Commencing in Figure 2, ovals and circles 20, have been added to highlight in at least one view where changes have been made which affect the representation in the previous view and thus allow for rapid detection by the reader of the changes made by the various steps in the method described herein.

Thus as seen in Figure 2b, the highlight oval 20 is shown around the north arms of tower 12d to indicate that changes are made from the representation of tower 12d in Figure 1b. Thus highlight oval 20 in Figure 2b indicates that a re-usable temporary line comprising temporary phases 22a, 22b, and 22c for the temporary top, center and bottom phases respectively have been strung under the corresponding top, center and bottom arms 24a, 24b, and 24c respectively of tower 12d. The temporary line extends from tower 12g via towers 12f, and 12e to temporary vertical dead-end

26, better seen in Figure 2a. Temporary phases 22a, 22b and 22c are maintained in a vertically spaced apart array from tower 12g to temporary vertical dead-end 26.

As seen in Figures 3 and 3a, a jumper 28a is installed between the top of the pole of vertical support 16a, that is, the East phase pole top, to the top temporary phase 22a. Jumper 28a is mounted between corresponding insulators or polymers 29a at the opposite ends of Jumper 28a.

As seen in Figures 4 and 4a, a Jumper 30a installed between the horizontal phase 14a, that is, the East phase, and the temporary Jumper 28a thereby energizing temporary Jumper 28a.

As seen in Figures 5 and 5a, a temporary Jumper 32b is installed from the top of the pole of vertical support 16b, that is, from the center phase pole top, to the temporary center phase 22b. A pair of insulators or polymers 33b is mounted at opposite ends of temporary Jumper 32b, between temporary Jumper 32b and the top of vertical support 16b and center temporary phase 22b.

As seen in Figures 6 and 6a, a Jumper 34b is installed from the horizontal center phase 14b to temporary Jumper 32b thereby energizing temporary Jumper 32b.

As seen in Figures 7, 7b and 43, polymer posts 39a, 39a are installed on the legs of tower 12d on each side and positioned above the bushings 38, 38 of the first temporary circuit breaker 36. A transfer bus 40 is run down each side of tower 12d between polymer posts 39a, 39a and the bushings 38, 38 of the first temporary circuit breaker 36.

As seen in Figures 8 and 8b, a Jumper 42a is installed from the top phase 14a to the adjacent transfer bus 40. With the first temporary circuit breaker 36 verified to be in its open condition, a second Jumper 42a is installed from the top temporary phase 22a to the other side of transfer bus 40, that is the side of transfer bus 40 adjacent top temporary phase 22a. This energizes one side of the first temporary circuit breaker 36.

As seen in Figures 9 and 9b, similar to the installation of the first temporary circuit breaker 36 and transfer bus 40 on tower 12d, discussed above in relation to Figure 7, a further second temporary circuit breaker 44 and corresponding transfer bus 46 is

set up adjacent to tower 12f. Transfer bus 46 is installed between the bushings 48, 48 on the second temporary circuit breaker 44 and polymer posts 49a, 49a on the legs of tower 12f, is set up adjacent to tower 12f.

As seen in Figure 10 and 10b, again with the second temporary circuit breaker 44 confirmed open, jumpers 50a is installed from top phase 14a and transfer bus 46, an
5 between transfer bus 46 and top temporary phase 22a respectively. This energizes one side of the second temporary circuit breaker 44.

As seen in Figure 11, a temporary jumper 52a is installed on adjacent tower 12g, from the top temporary phase 22a to a suspension insulator 54a on the end of
10 the corresponding arm of tower 12g, so as to leave an extra length 53a of jumper 52a coiled for use later as described below.

As seen in Figures 12 and 12b, first temporary circuit breaker 36 on tower 12d is closed thereby energizing the top temporary phase 22a via bus 40 and Jumpers 42a between vertical support 16a and tower 12g at the potential of top phase 14a', that
15 is, the East phase potential.

As seen Figures 13 and 13b, the second temporary circuit breaker 44 is then closed thereby paralleling the top temporary phase of 22a between tower 12g and temporary vertical dead-end 26 and top phase 14a, that is, the East phase 14a'.

As seen in Figures 14 and 14a, a jumper 56a is next installed across insulator 29a
20 on temporary jumper 28a to thereby parallel the top phase 14a (East phase 14a') and top temporary phase 22a around vertical support 16a.

As seen in Figures 15 and 15a, the parallel around vertical support 16a is broken by the removal of permanent Jumper 58a, seen for example installed in Figure 14, from between East phase 14a' and top phase 14a.

As seen in Figure 16, temporary Jumper 52a, which was installed in the step illustrated in Figure 11, is extended so that the extra length 53a of Jumper 52a is extended to the section of top phase 14a heading east from tower 12g. This completes a paralleling of top phase 14a around the dead-end at tower 12g.
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As seen in Figures 17 and 17a, the permanent Jumper 60a as seen for example in
30 Figure 16, is removed from between the sections of top phase 14a which are

oriented substantially North and East on either side of tower 12g thereby breaking the parallel around the dead-end at tower 60a.

As seen in Figures 18 and 18b, the second temporary breaker 44 is then opened so as to break parallel of top phase 14a and temporary phase 22a, between tower 12g and vertical support 16a.

As seen Figures 19 and 19b, the first temporary breaker 36 is next opened thereby de-energizing top phase 14a between tower 12g and vertical support 16a.

As seen in Figures 20 and 20b, the temporary Jumpers are removed from their corresponding transfer bus 46, and 40 respectively thereby respectively de-energizing and clearing temporary circuit breakers 44 and 40.

Top phase 14a may now be worked on or replaced as its energized load has been transferred to, so as to be carried by, top temporary phase 22a between tower 12g and vertical support 16a, or the work or replacement may be delayed until one or more of the other energized phases have been de-energized and the work then done on all of the de-energized phases.

The steps in the de-energizing of the center and bottom phases, and the transferring of the load to the corresponding re-usable temporary conductor phases, is set out in Figures 21 through 42. The steps in relation to the center energized phases are set-out in Figs 21- 31. The steps in relation to the bottom energized phase are set out in Figs 32 - 42.

It will be understood that, although not shown in the Figures, the de-energized phases 14a, 14b, 14c may be repaired or replaced, following which the process set out above for each phase is reversed so as to re-transfer the load back from the temporary phases to the now-repaired/replaced phases. Once the temporary phases are de-energized they are removed for re-use in the next section of energized line needing repair or replacement.

An example is provided of a procedure using a temporary conductor as a removable tool in the repair or re-conductoring (collectively referred to as "re-conductoring") of three phases in a horizontal configuration. Thus as seen by way of example in Figure 44a, a typical H-frame structure having vertical pole 102 and cross-arm 101,

is illustrated. Post suspension 112 are suspended from cross-arm 101 so as to support conductors 114a, 114b and 114c. Conductors 114a, 114b and 114c typically carry A phase, B phase and C phase loads respectively.

As seen in Figure 44b, in the example illustrated, a temporary insulator 120 is mounted to the vertical pole 102 closest to conductor 114a; that is, the conductor carrying the A phase at the outset of the re-conductoring procedure. As would be known skilled in the art, the arrangement and position of temporary post insulator 102 is merely one example of how the temporary conductor 122, seen in Figure 45, may be suspended on or from H-frame structure 100. A further example is provided in Figure 57 where temporary insulators 124 are suspended in a "V" arrangement on structure 100 so as to thereby support temporary conductor 122 therebetween. Thus, with temporary post insulator 120 mounted to vertical pole 102, as seen in Figure 45, temporary conductor 122, which initially is not energized and thus labelled as the "D" phase, is mounted to, so as to be suspended from, the free or distal end of temporary post insulator 120. In the re-conductoring procedure which follows for the horizontal configuration of conductors seen commencing in Figure 44, the labels "A phase", "B phase", "C phase", and "D phase", refer, respectively, to an A phase load carried in the corresponding conductor, a B phase load carried in the corresponding conductor, a C phase load carried in the corresponding conductor and a de-energized conductor (the D phase).

As seen in Figure 46, the A phase load in conductor 114a is transferred to temporary conductor 122 as indicated by arrow AA, resulting in temporary conductor 122 carrying the A phase load and conductor 114a becoming the D phase upon it be de-energized. That is, the A phase load is transferred to what was the D phase conductor 122 in Figure 45, and the conductor 114a which was the A phase in Figure 45 is de-energized to become the new D phase.

As seen in Figure 47 once the A phase load has been transferred to temporary conductor 122, conductor 114a may be re-conducted.

As seen in Figure 48 the next step in this embodiment of the procedure is to transfer the B phase load, as indicated by arrow BB, from conductor 114b to D phase conductor 114a and de-energize conductor 114b. Thus the B phase is now carried

in conductor 114a and, with conductor 114b de-energized, conductor 114b may be re- conductored as it is now the de-energized D phase as seen in Figure 49.

As seen in Figure 50, the next step in this embodiment of the procedure is to transfer the C phase load, as indicated by arrow CC, from conductor 114c to the now re-
5 conductored conductor 114b and to de-energize conductor 114c. Thus the C phase load is now carried by conductor 114b, and conductor 114c becomes the de-energized D phase. With conductor 114c now the de-energized D phase as seen in Figure 51, conductor 114c may be re-conductored.

With conductors 114a, 114b and 114c now re-conductored, the process is reversed
10 so that, as seen in Figure 52, the C phase load is transferred back to conductor 114c as indicated by arrow CC', and conductor 114b de-energized. Thus the C phase load is returned to conductor 114c, and 114b becomes the de-energized D phase.

As seen in Figure 53, in the next step of the process, the D phase load is transferred back from conductor 114a to conductor 114b, and conductor 114a de- energized as
15 indicated by arrow BB'. Thus conductor 114b is returned to the B phase and conductor 114a becomes the D phase.

As seen in Figure 54, in the next step of the process, the B phase load is returned from temporary conductor 112 to conductor 114a, as indicated by arrow AA'. Thus conductor 114a again becomes the A phase and temporary conductor 122 is
20 returned to the D phase.

As indicated in Figure 55, temporary conductor 122, that is, the D phase in Figure 54 is now removed so that it may be reused and installed on for example a next section of conductors 114a, 114b and 114c to be re-conductored. In Figure 56 the temporary post insulator 120 has been removed thereby returning H-frame structure
25 100 to its original condition.

What is claimed is:

1. A method of using a temporary conductor as a re-usable tool in maintaining, repairing or re-conductoring at least one energized phase, wherein said at least one energized phase is energized at a voltage potential and strung in at least a first section, the method comprising:

a) stringing said temporary conductor between support structures at either end of said first section, then energizing said temporary conductor by bringing said temporary conductor to said voltage potential and electrically paralleling said temporary conductor with said energized phase,

b) de-energizing and then maintaining, repairing or reconductoring said de-energized energized phase,

c) re-energizing and electrically paralleling said energized phase,

d) de-energizing and removing said temporary conductor for later re-use as said re-usable tool in a second section of said energized phase.

2. A method of using a temporary conductor as a re-usable tool in maintaining at least one energized phase, wherein said at least one energized phase is energized at a voltage potential and strung in at least a first section between first and second support structures, the method comprising:

a) providing a temporary conductor,

b) stringing said temporary conductor so as to substantially aligned with and alongside, and spaced apart from, said energized phase,

c) energizing by bringing said temporary conductor to said voltage potential of said energized phase, and electrically paralleling said temporary conductor with said energized phase

d) de-energizing said phase,

e) maintaining by way of repairing or re-conductoring said de-energized phase,

f) re-energizing said energized phase and electrically paralleling said energized phase with said temporary conductor,

g) de-energizing said temporary conductor,

h) removing said temporary conductor for later re-use as said re-usable tool in a second section of said energized phase.

3. A method of using temporary conductors as a re-usable tool in live re-conductoring of energized conductors, wherein the energized conductors are at a voltage potential and strung in at least a first section, between at least first and second support structures, and also in a contiguous second section, contiguous to the first section, between the second and third support, wherein in both said first and second sections of said energized conductors are contiguous between said first and second sections, and wherein said energized conductors comprise a spaced-apart energized array of energized conductors, and wherein the energized conductors in said array of energized conductors comprise separate phases,

the method comprising in said first section:

- a) providing a re-usable set of temporary conductors,
- b) stringing the set of temporary conductors in a substantially aligned, spaced apart temporary array alongside, and spaced apart from, said array of energized conductors so that each said energized conductor of said array of energized conductors has a corresponding temporary conductor of said set of temporary conductors alongside it,
- c) commencing with a first energized phase of said array of energized conductors, energizing so as to bring a corresponding first temporary conductor of said set of temporary conductors to said voltage potential of said first energized phase, electrically paralleling said first temporary conductor with said first energized phase, and then de-energizing said first conductor,
- d) maintaining by way of repairing or re-conductoring, said de-energized first phase conductor,
- e) repeating in sequence steps (a) through (d) for each subsequent energized phase in said array of energized conductors and corresponding temporary conductor in said set of temporary conductors,

- f) for those energized phases not maintained in step (d), then maintaining those energized phases, then,
- g) re-energizing said energized phases and electrically paralleling said energized phases with said temporary conductors,
- 5 h) de-energizing said temporary conductors,
- i) removing said temporary conductors for later re-use as said re-usable tool in said second section,

the method further comprising in said second section:

- j) providing said set of temporary conductors,
 - 10 k) repeating steps (a) through (i), whereby said maintenance on said first and second sections occurs without transposing relative positions of said energized phases in said array of energized phases, and whereby the temporary conductors are re-usable from said first section to said second section.
- 15 4. An apparatus for use in the method of claim 1 comprising the temporary conductor, or the set of temporary conductors, adapted for re-use in repeated installing and removing of the temporary conductor or set of temporary conductors respectively in and from the first section or at least one section of energized conductor.
 - 20 5. An apparatus for use in the method of claim 2 comprising the temporary conductor, or the set of temporary conductors, adapted for re-use in repeated installing and removing of the temporary conductor or set of temporary conductors respectively in and from the first section or at least one section of energized conductor.
 - 25 6. An apparatus for use in the method of claim 3 comprising the temporary conductor, or the set of temporary conductors, adapted for re-use in repeated installing and removing of the temporary conductor or set of temporary conductors respectively in and from the first section or at least one section of energized conductor.

1/100

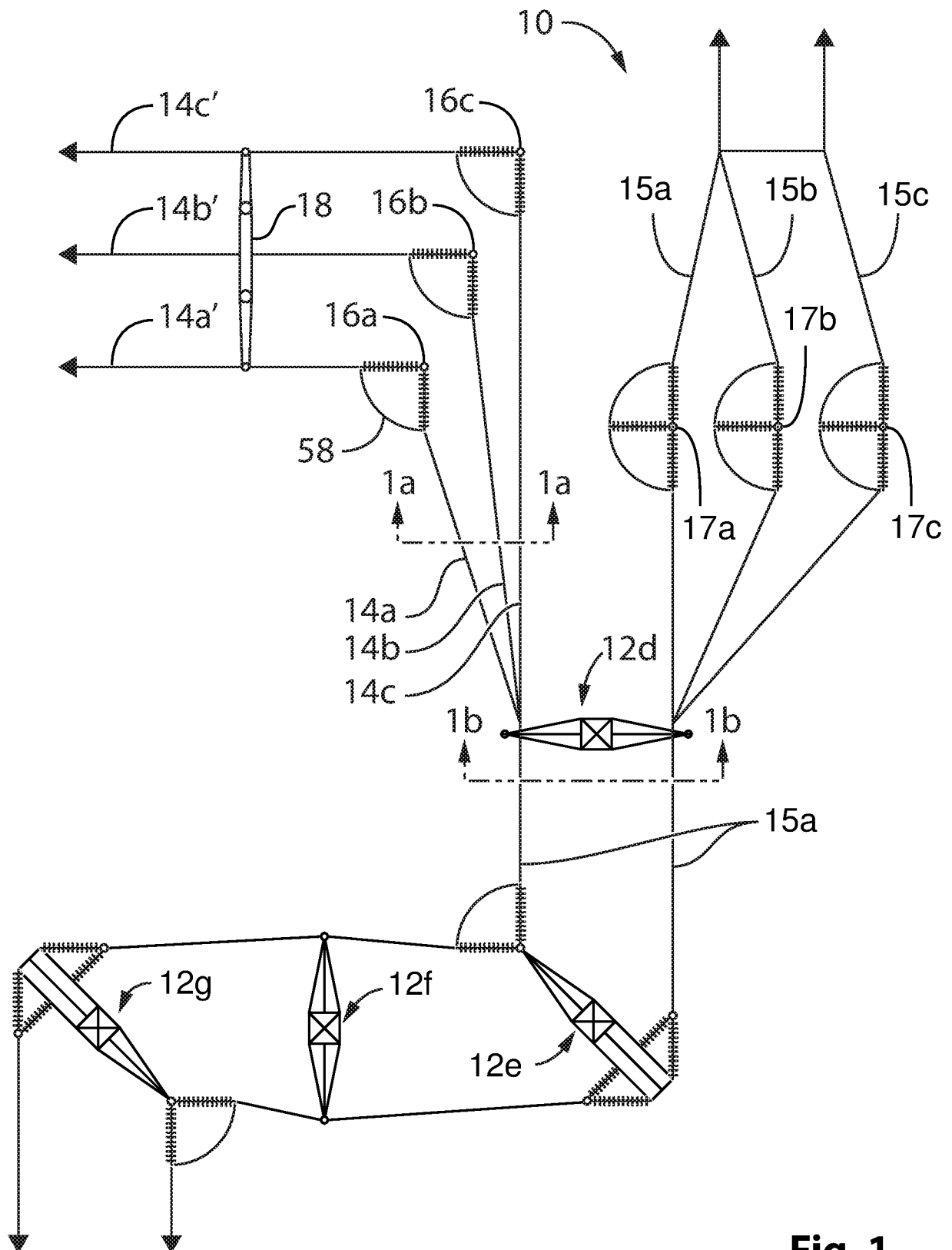


Fig. 1

2/100

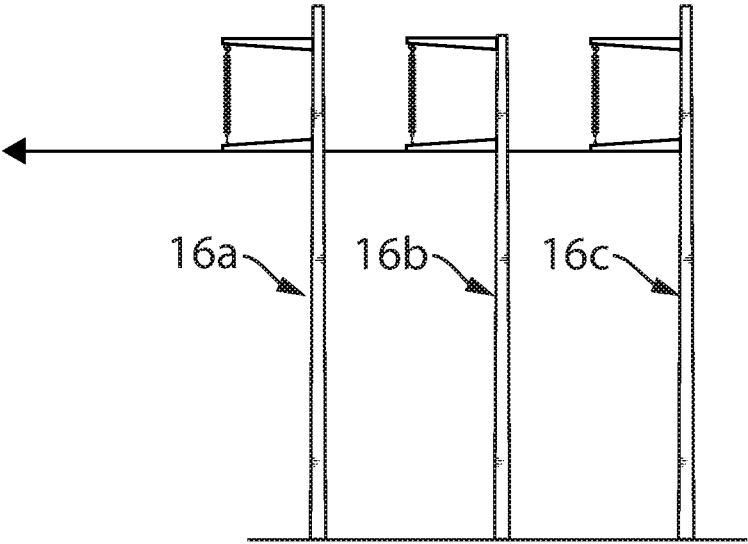


Fig. 1a

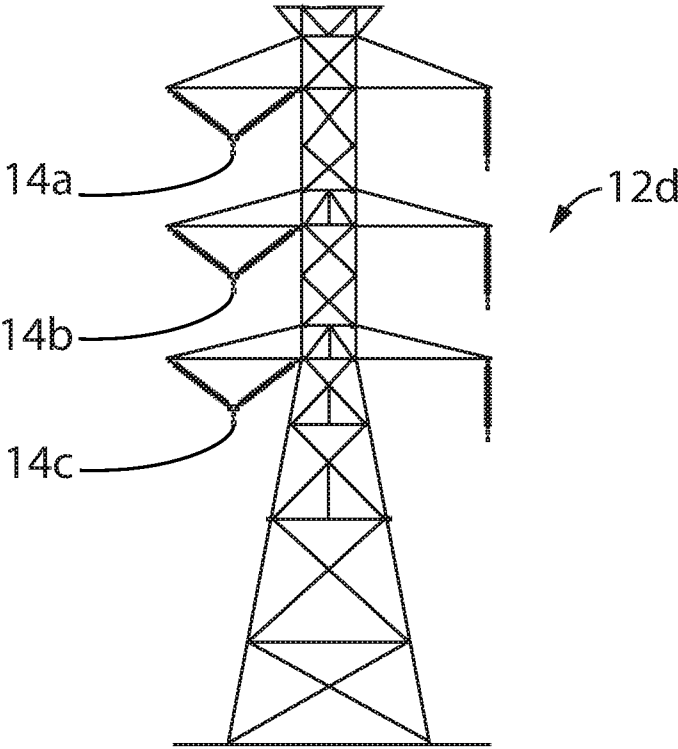


Fig. 1b

3/100

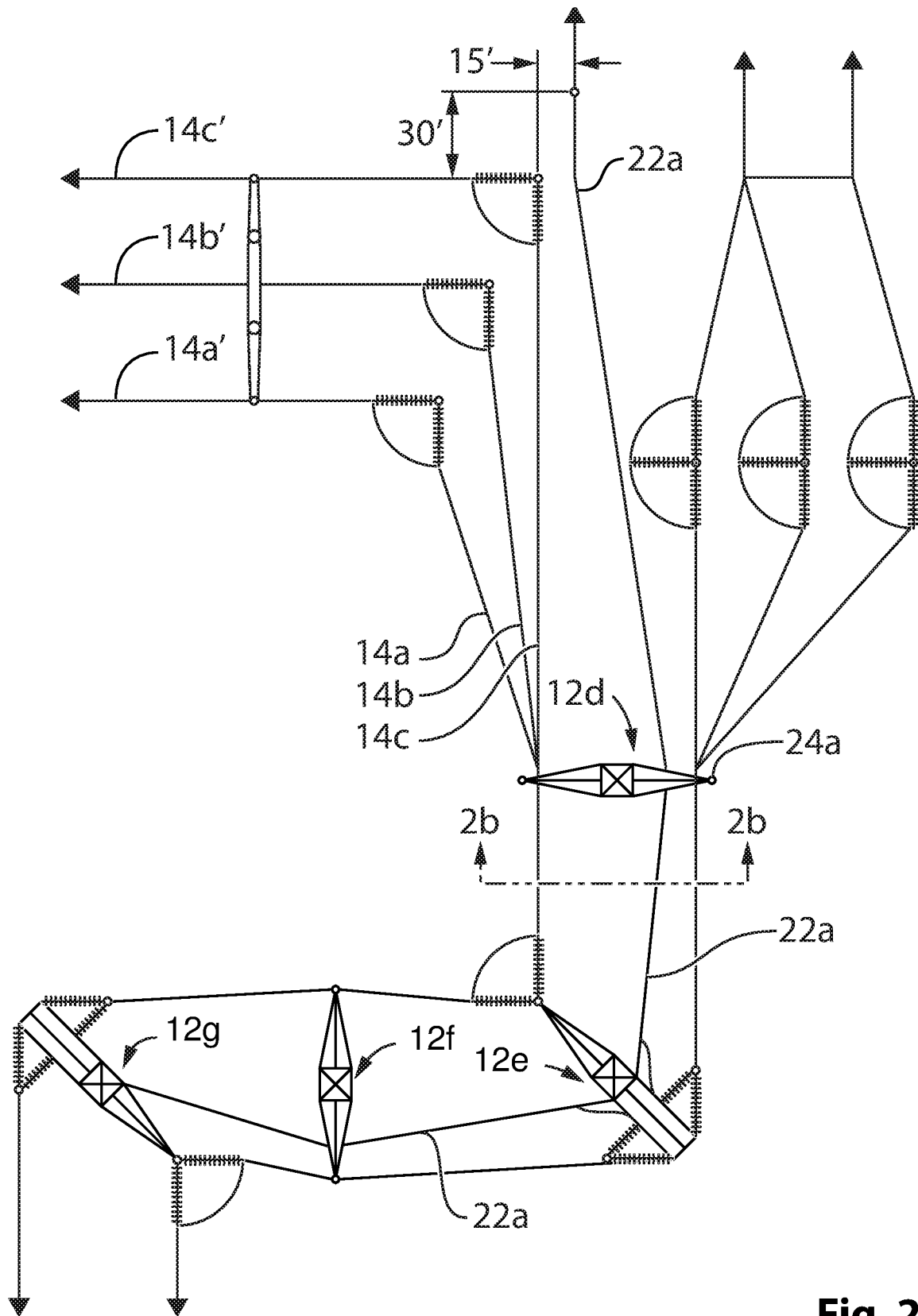


Fig. 2

4/100

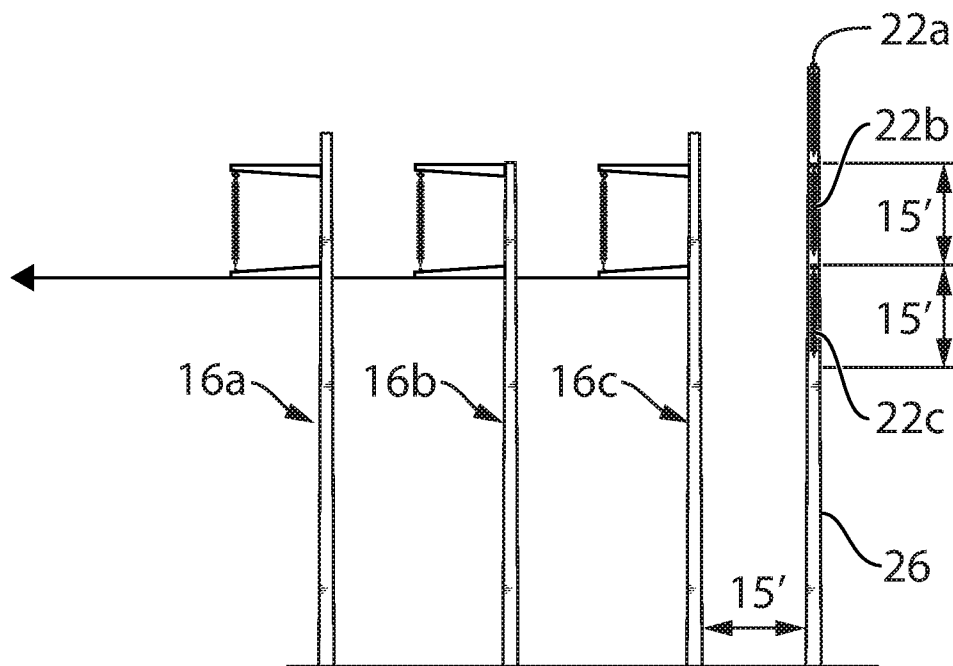


Fig. 2a

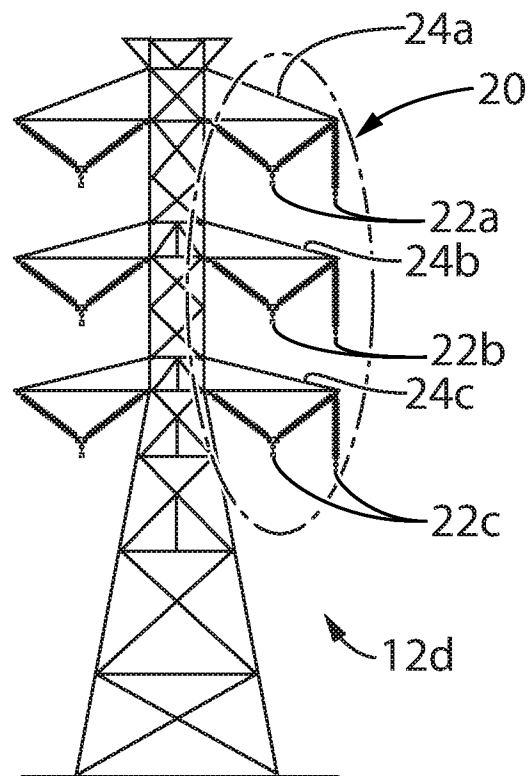


Fig. 2b

5/100

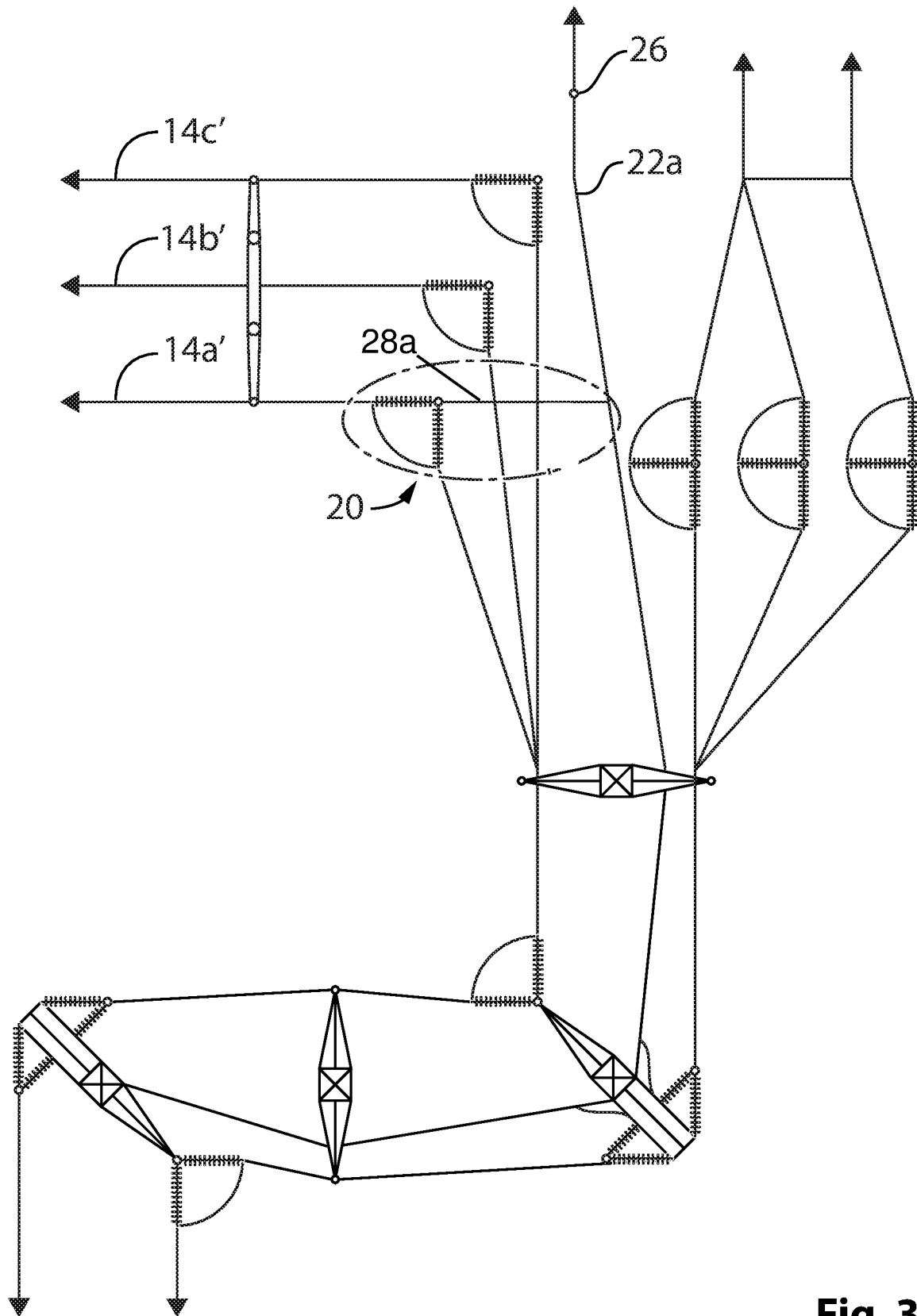


Fig. 3

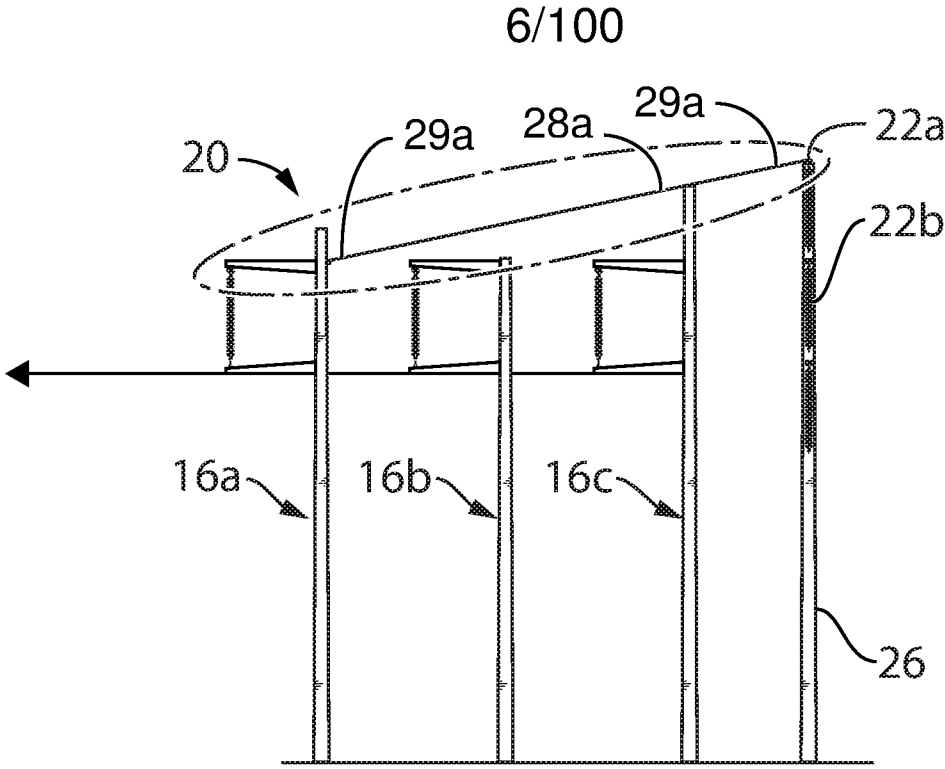


Fig. 3a

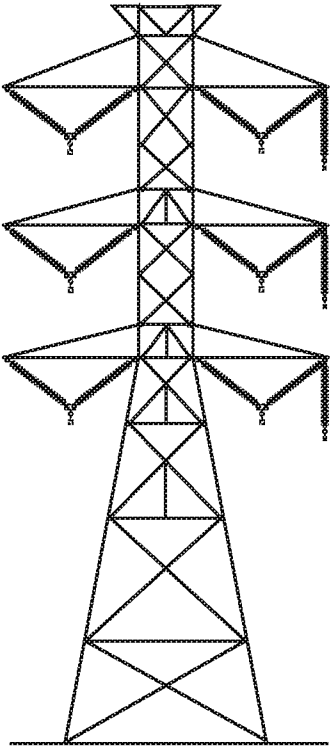
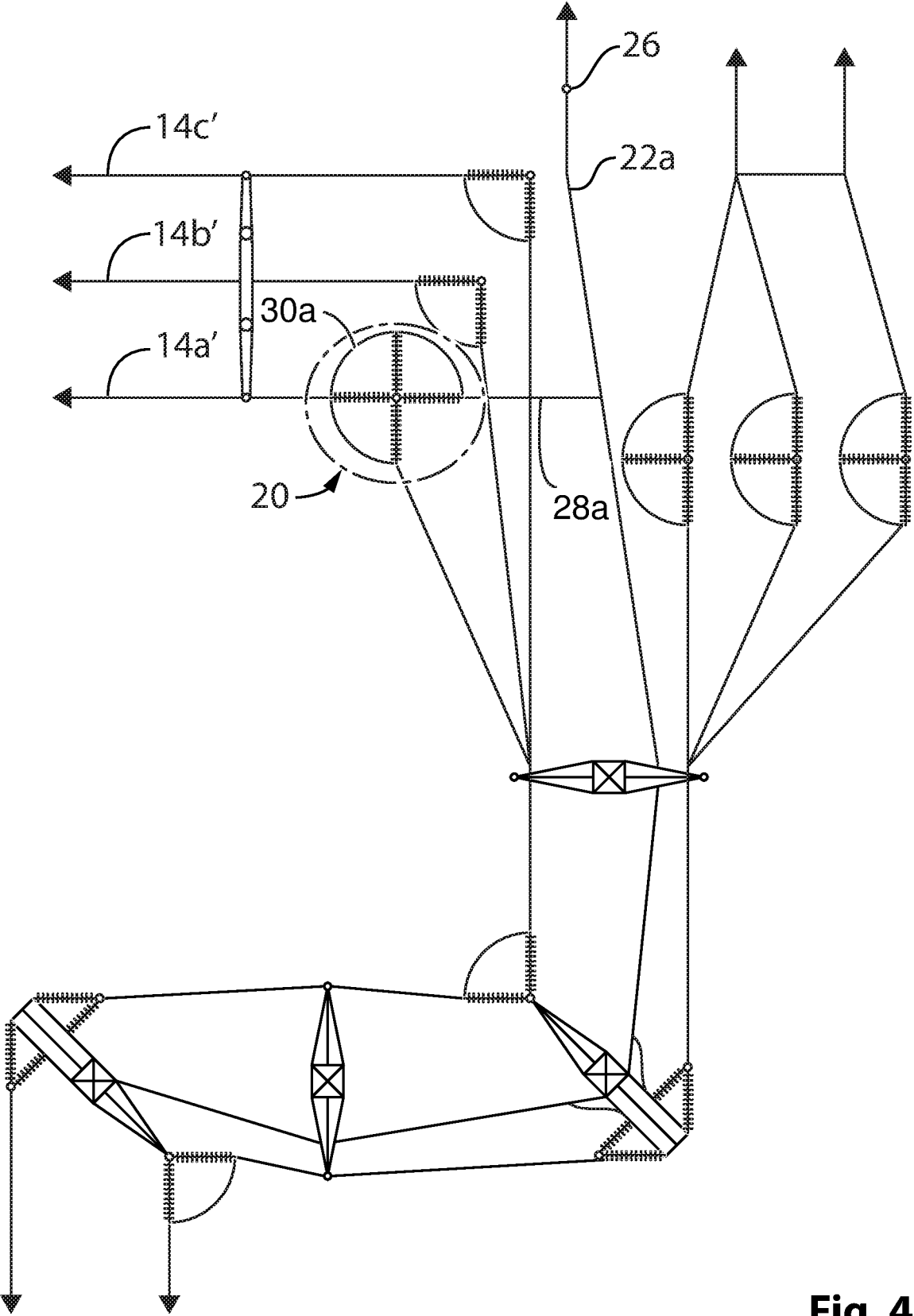


Fig. 3b

7/100



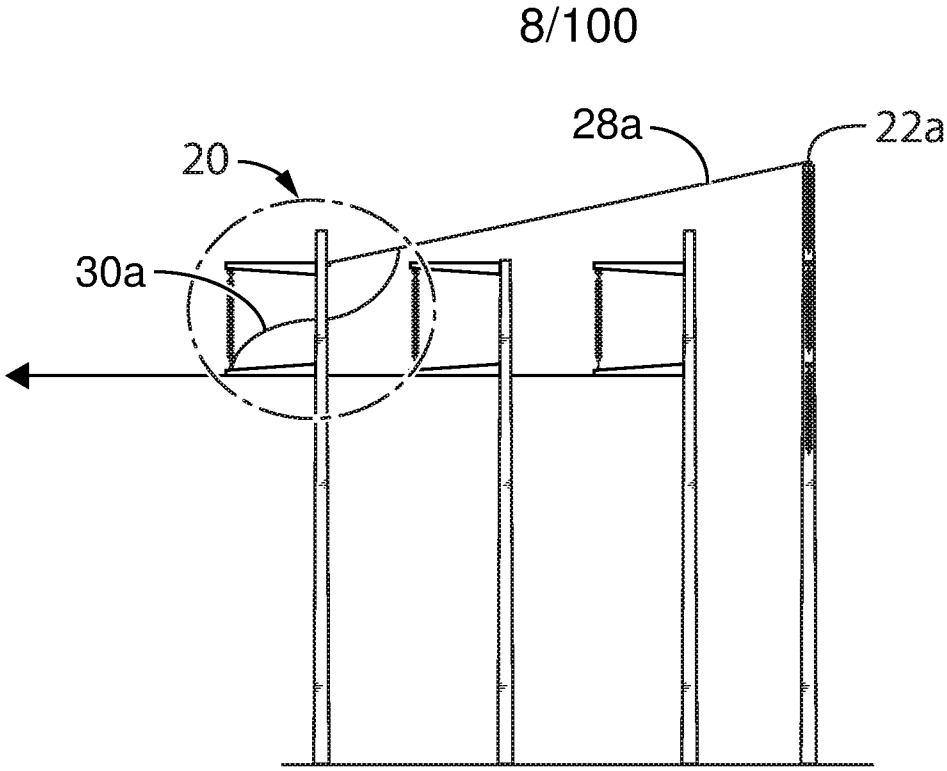


Fig. 4a

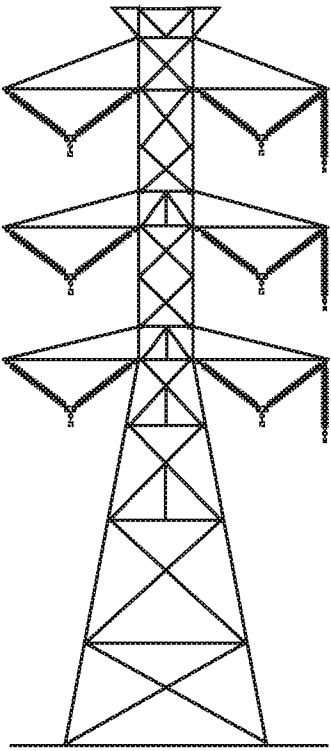


Fig. 4b

9/100

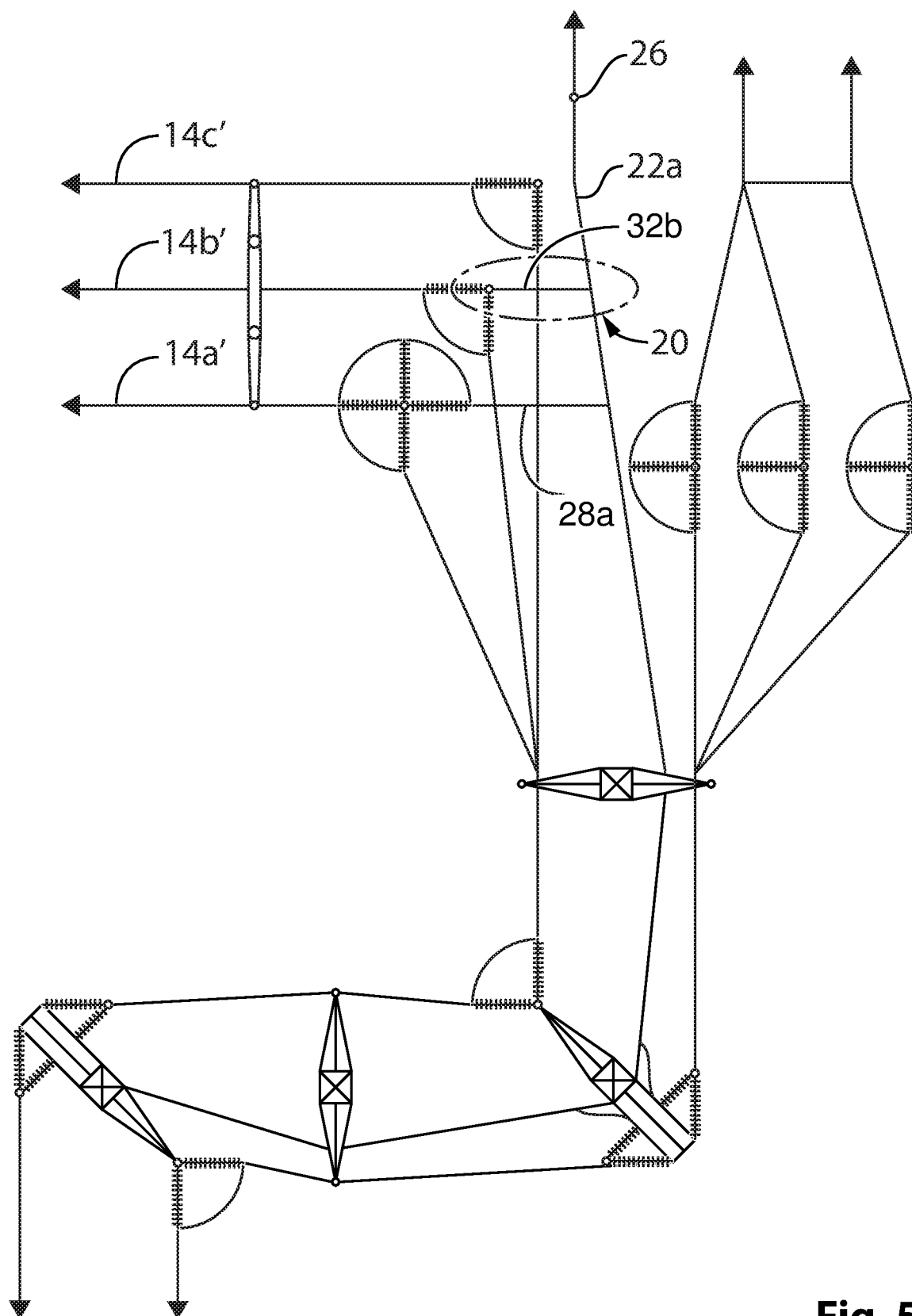


Fig. 5

10/100

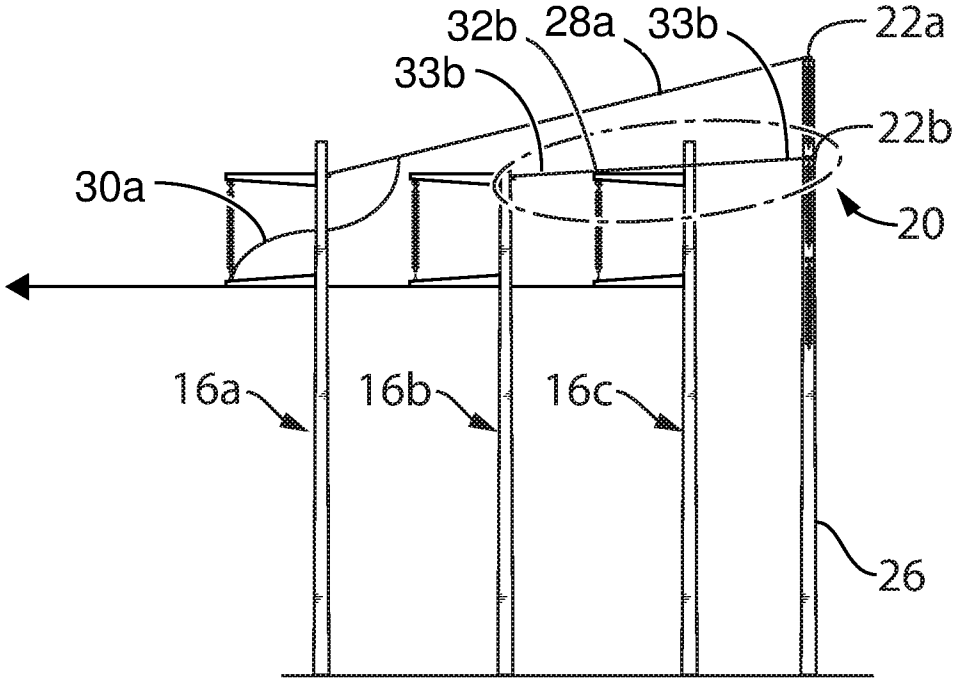


Fig. 5a

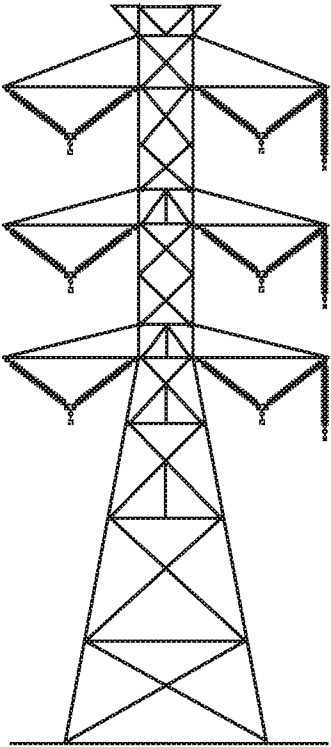


Fig. 5b

11/100

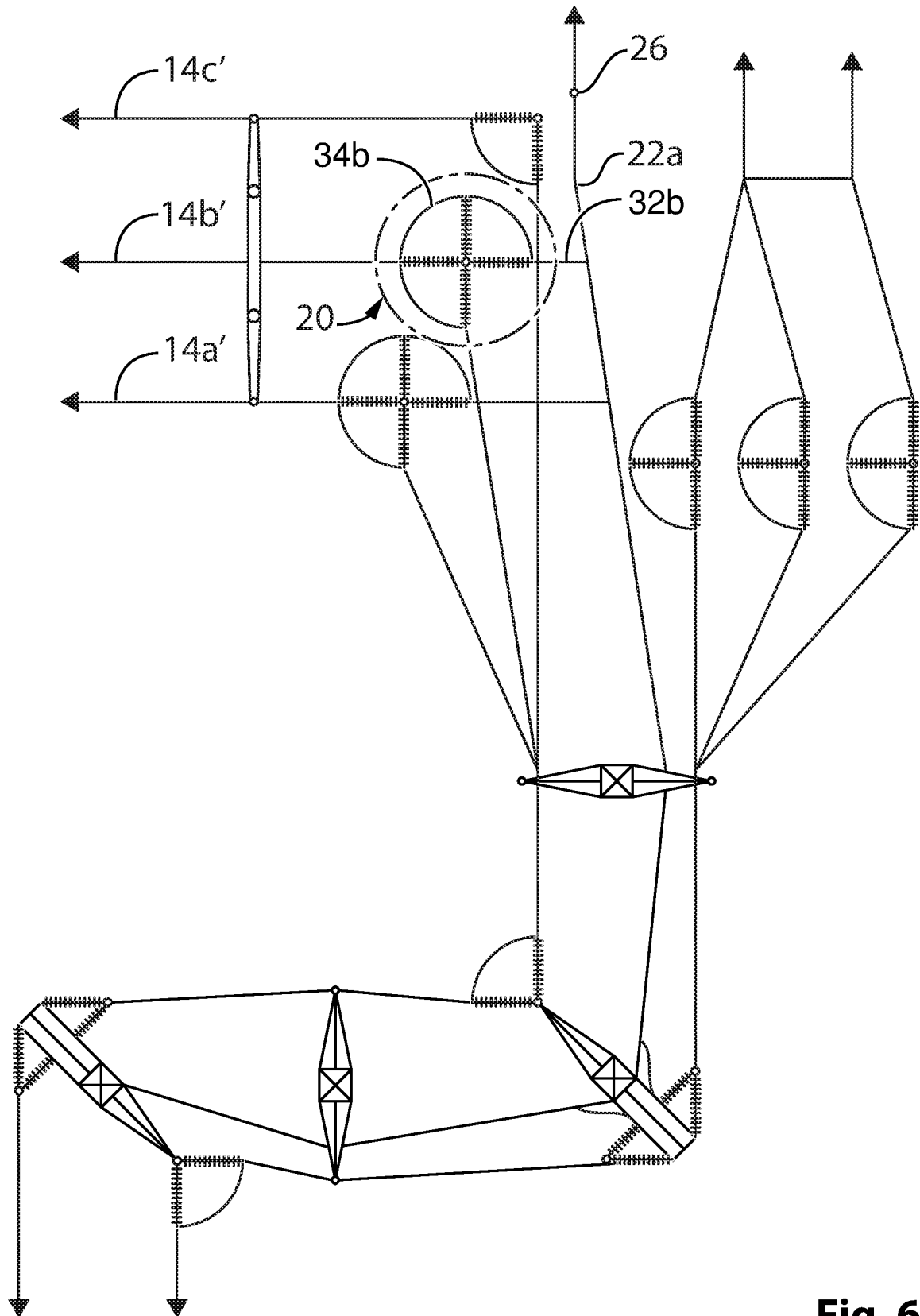


Fig. 6

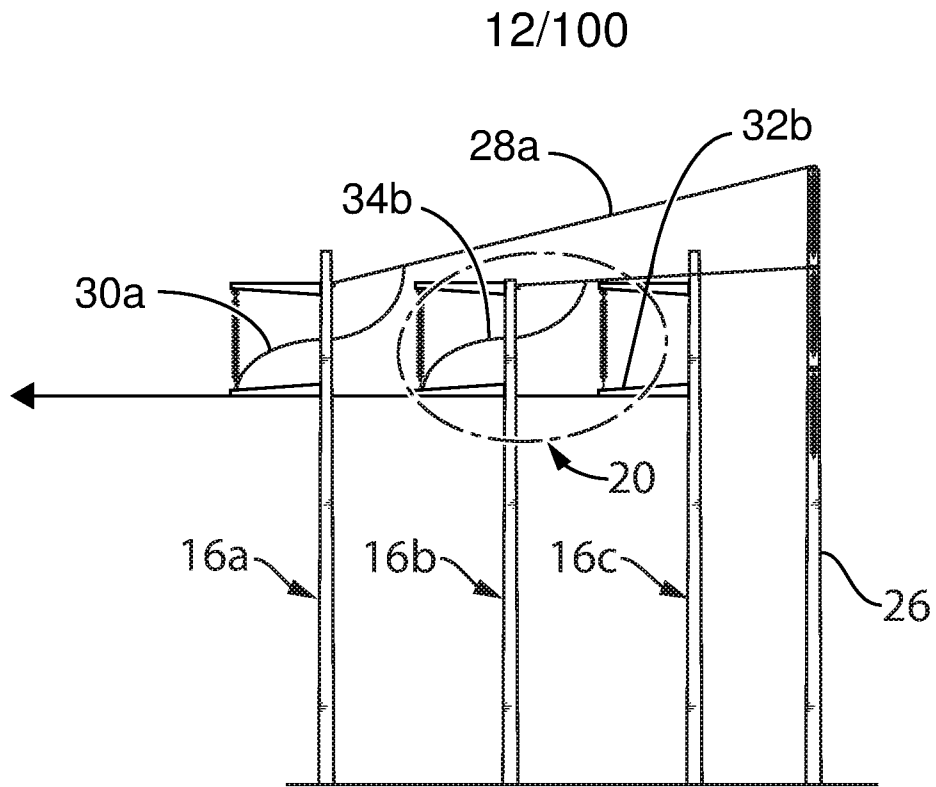


Fig. 6a

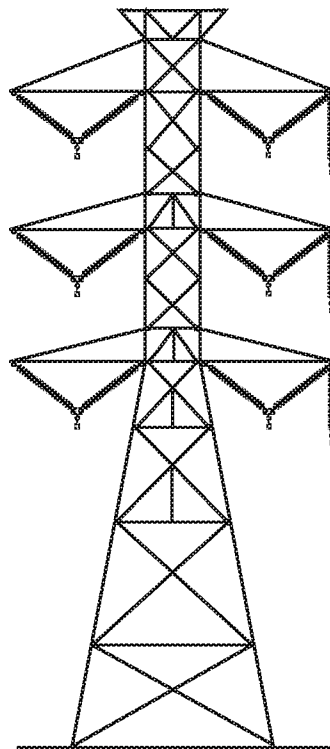


Fig. 6b

13/100

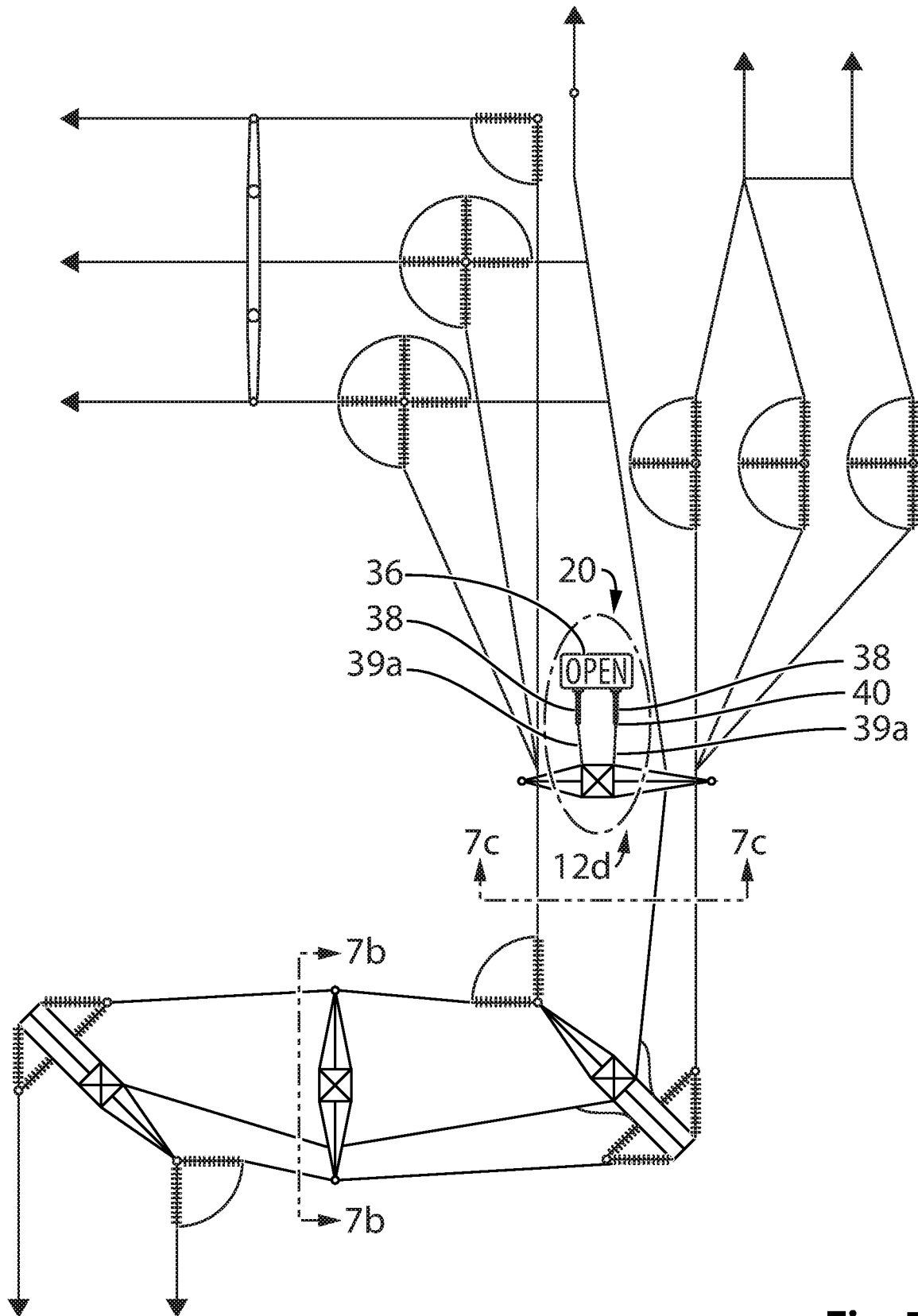


Fig. 7

14/100

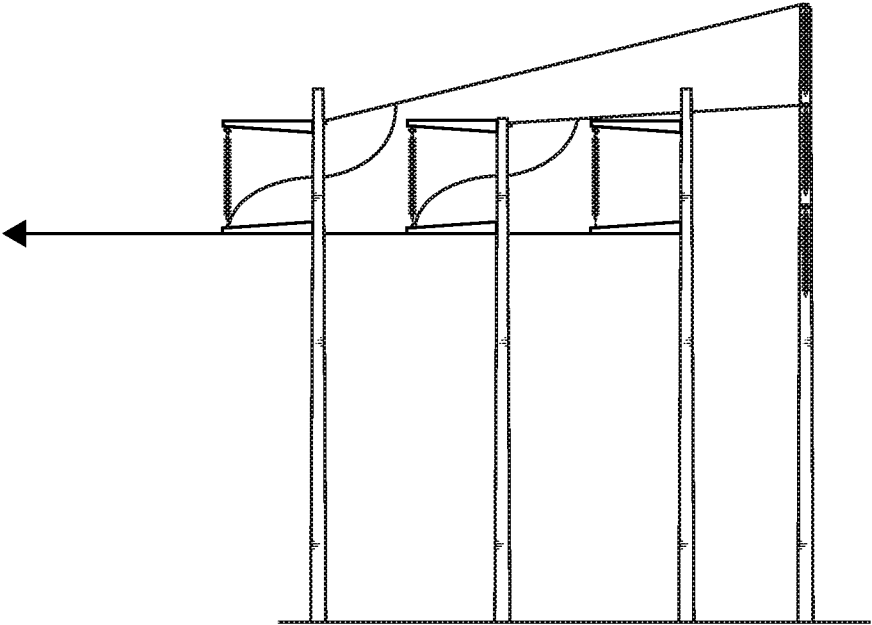


Fig. 7a

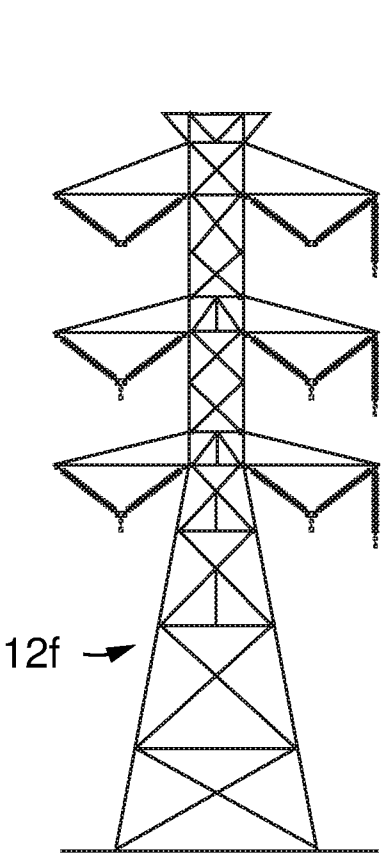


Fig. 7b

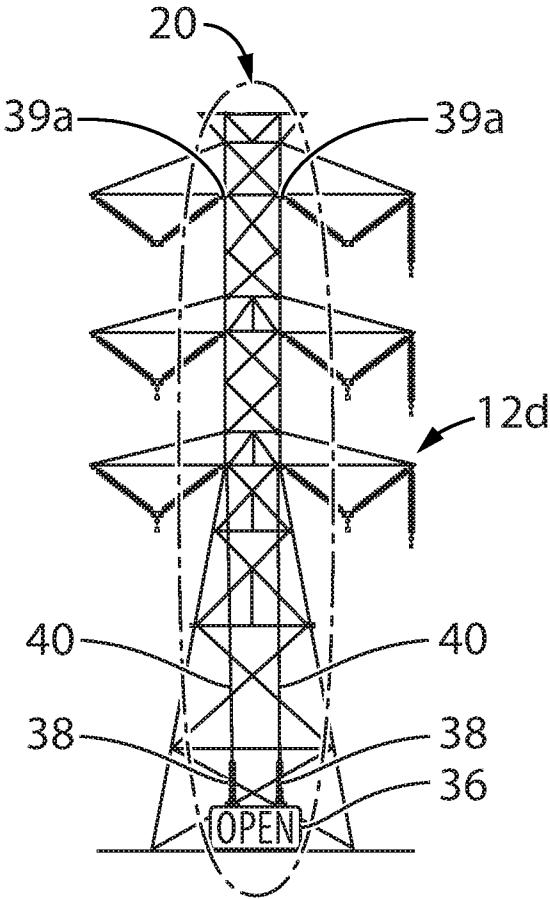


Fig. 7c

15/100

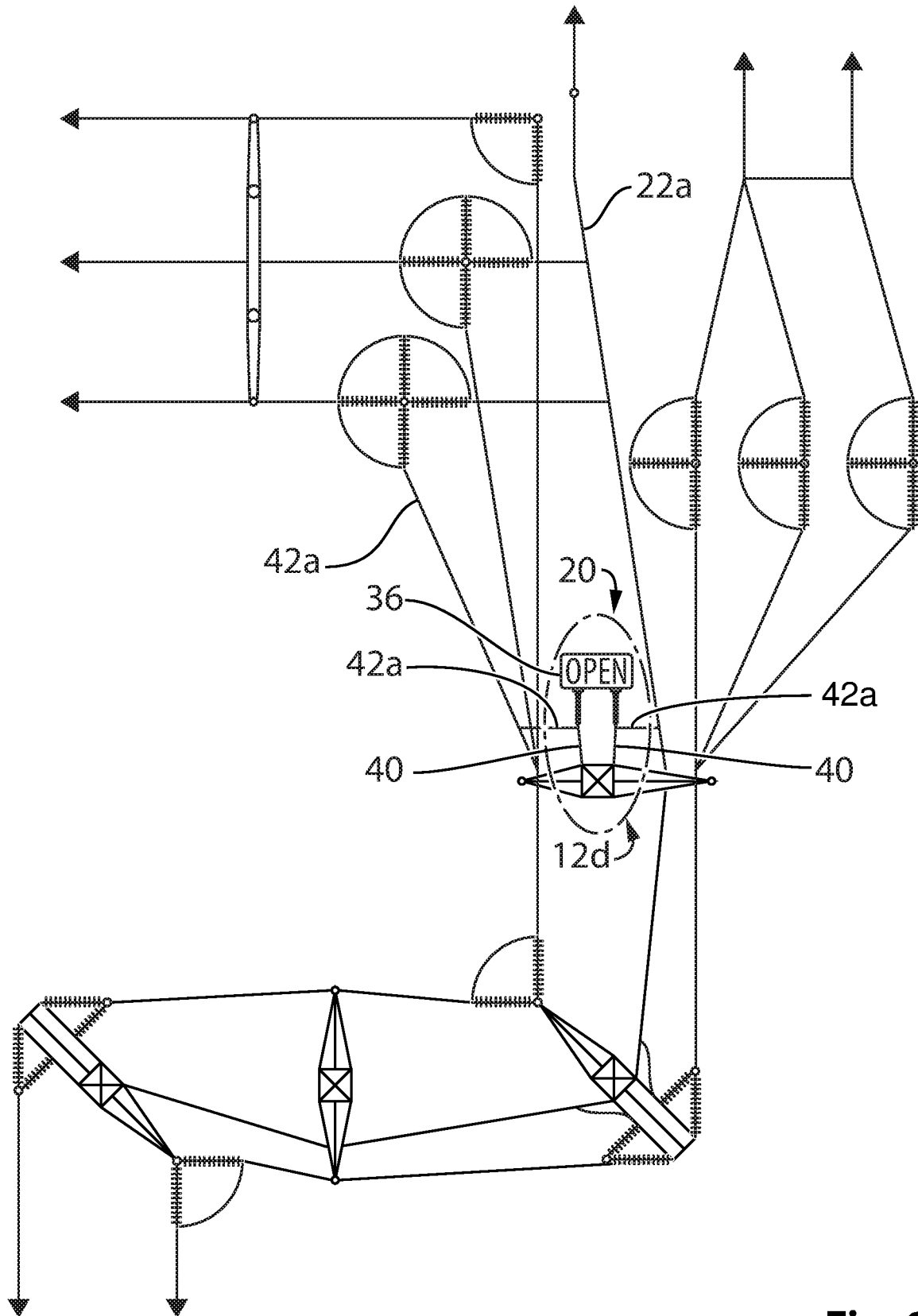


Fig. 8

16/100

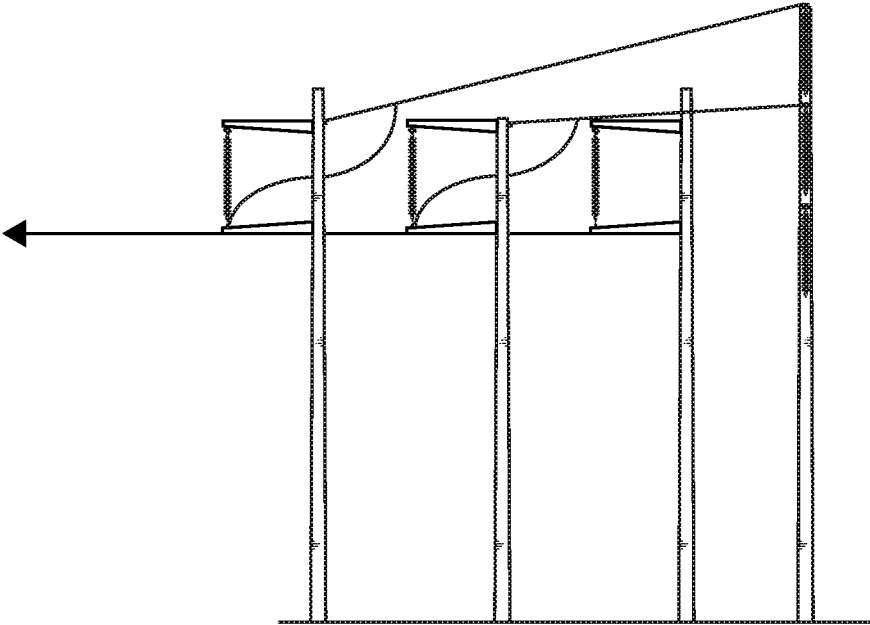


Fig. 8a

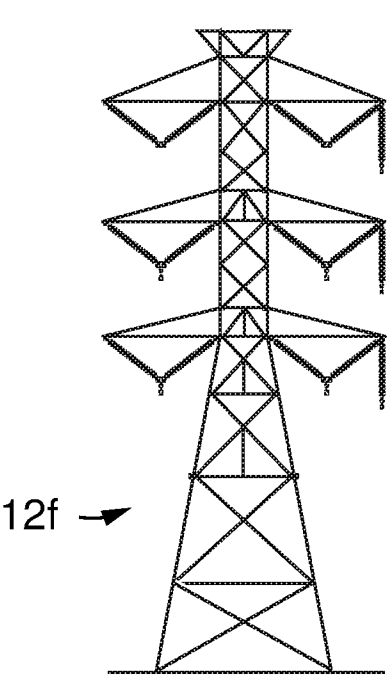


Fig. 8b

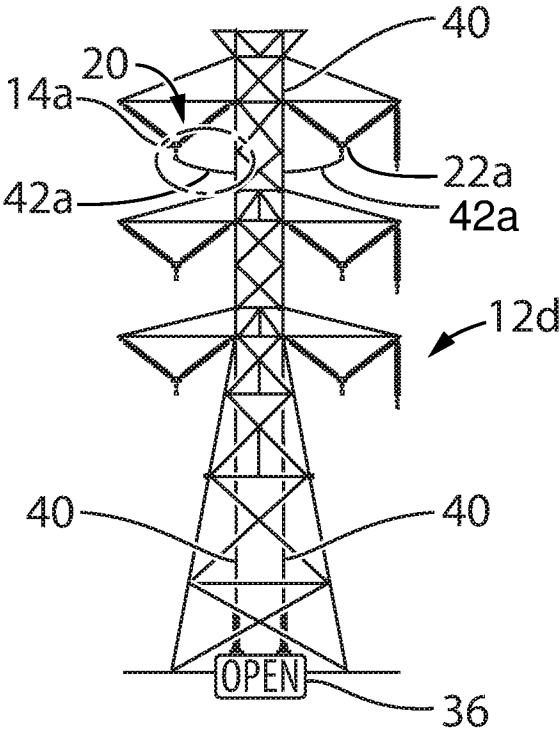


Fig. 8c

17/100

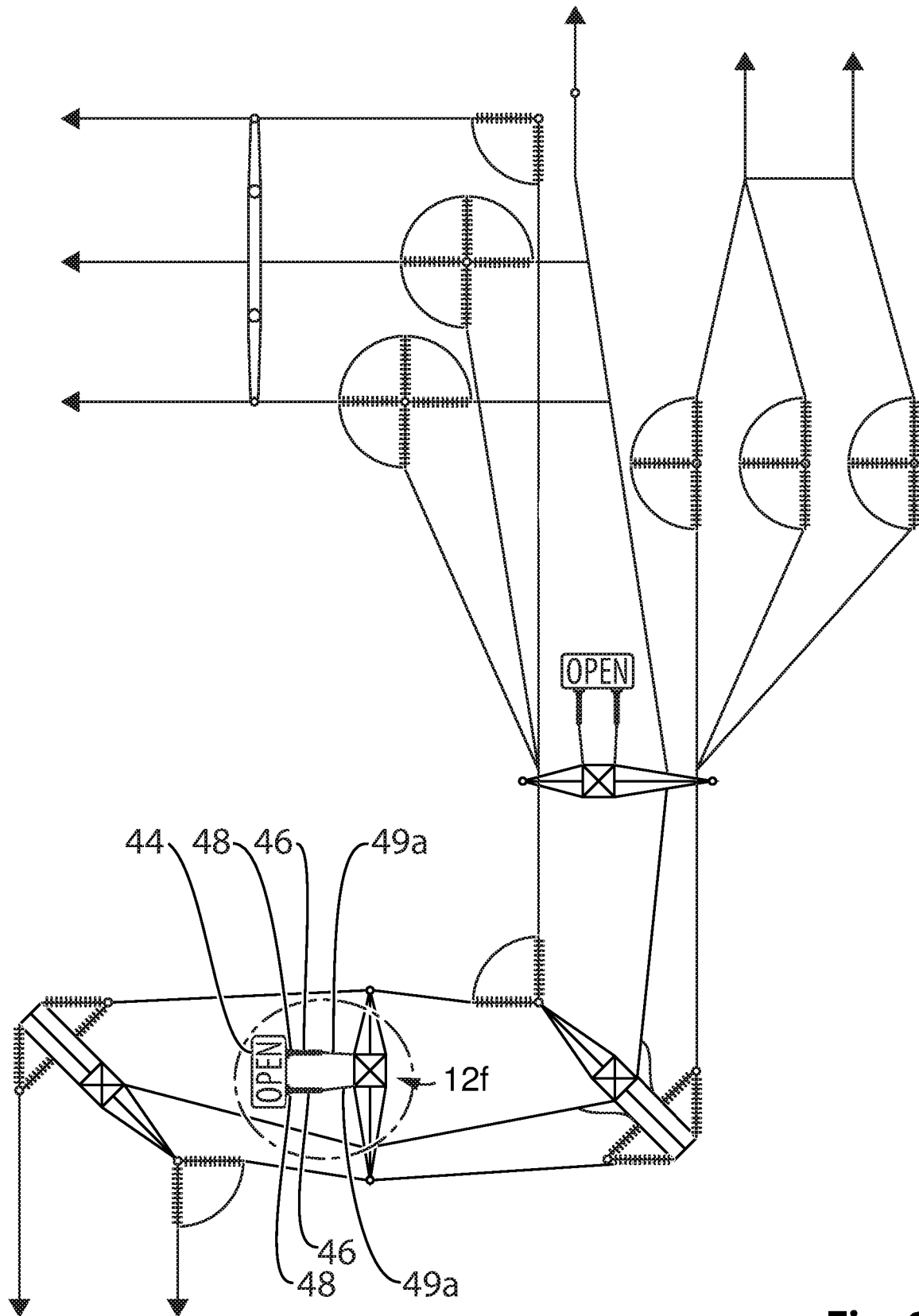


Fig. 9

18/100

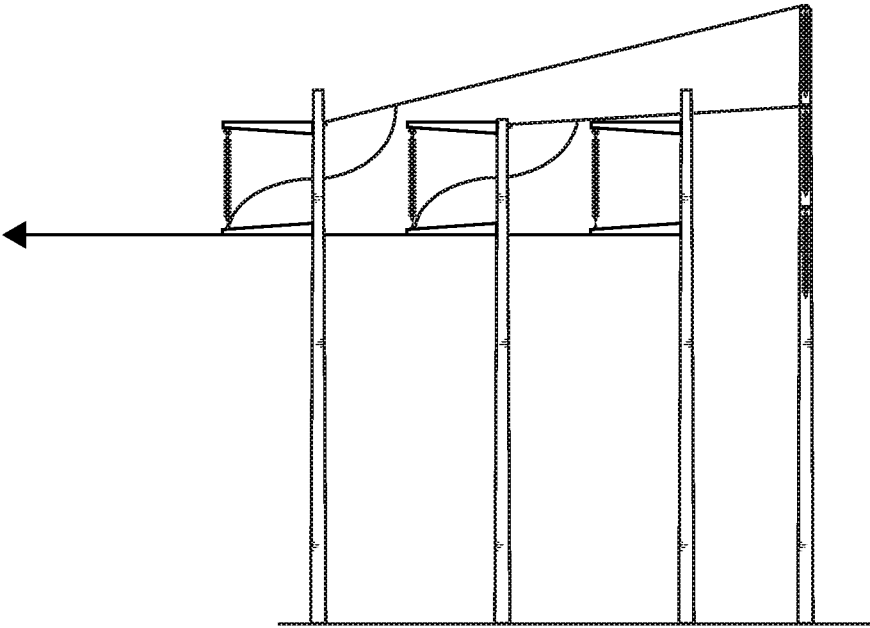


Fig. 9a

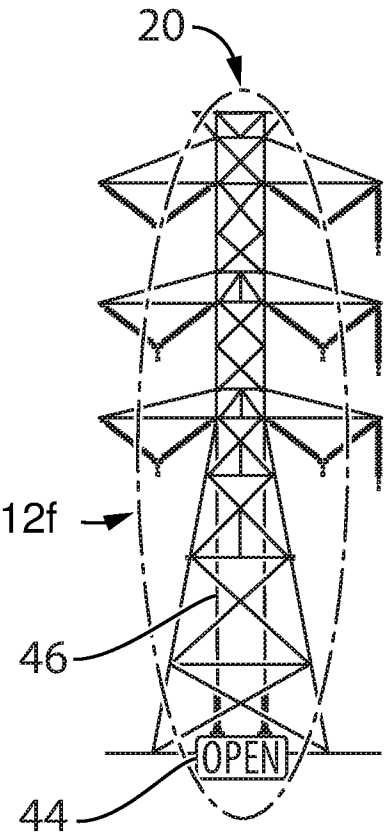


Fig. 9b

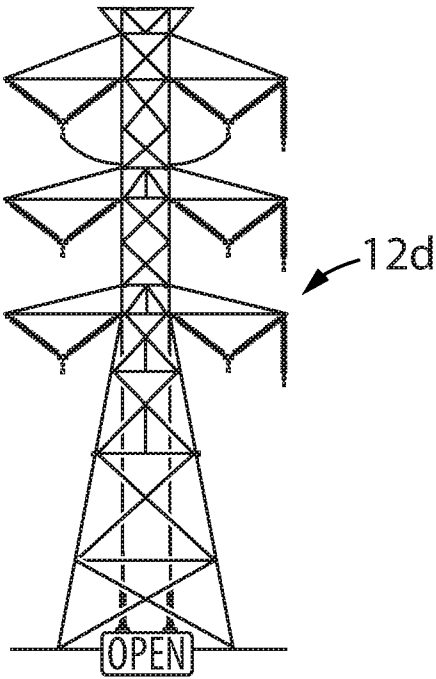


Fig. 9c

19/100

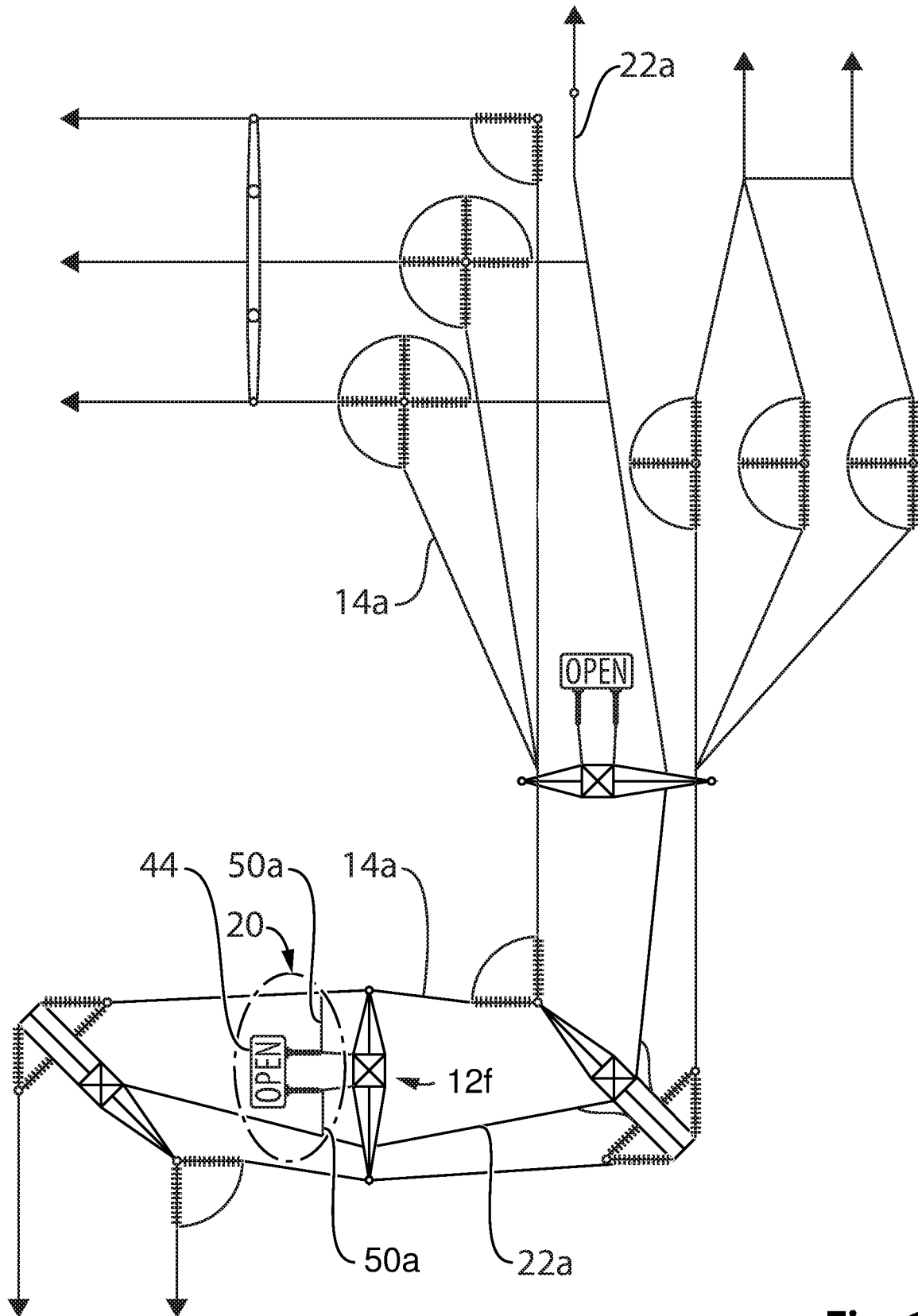


Fig. 10

20/100

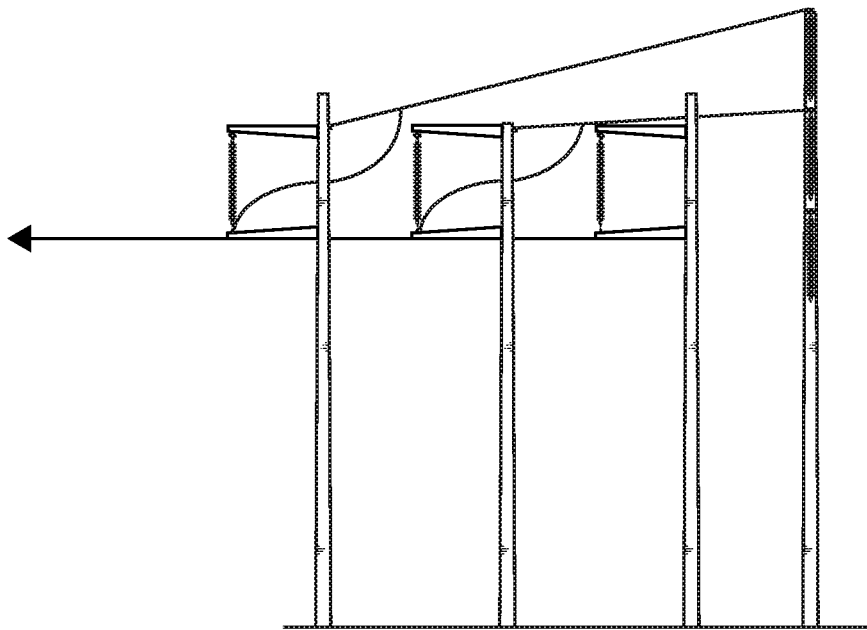


Fig. 10a

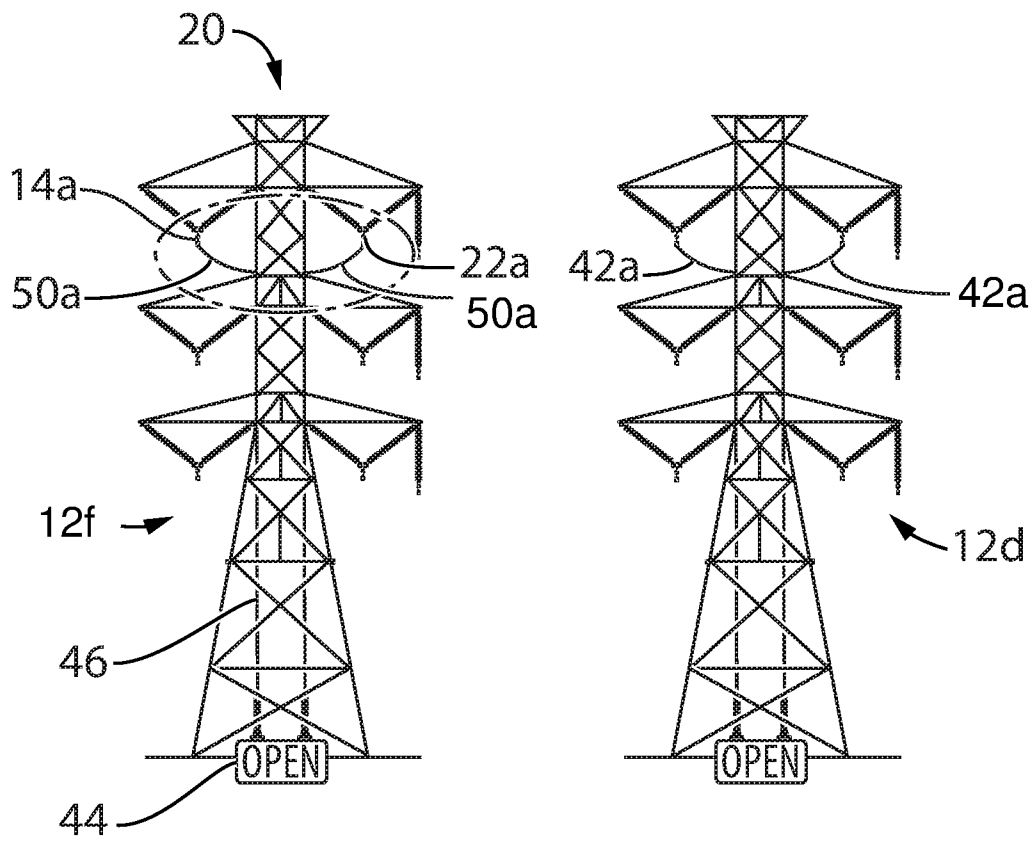


Fig. 10b

Fig. 10c

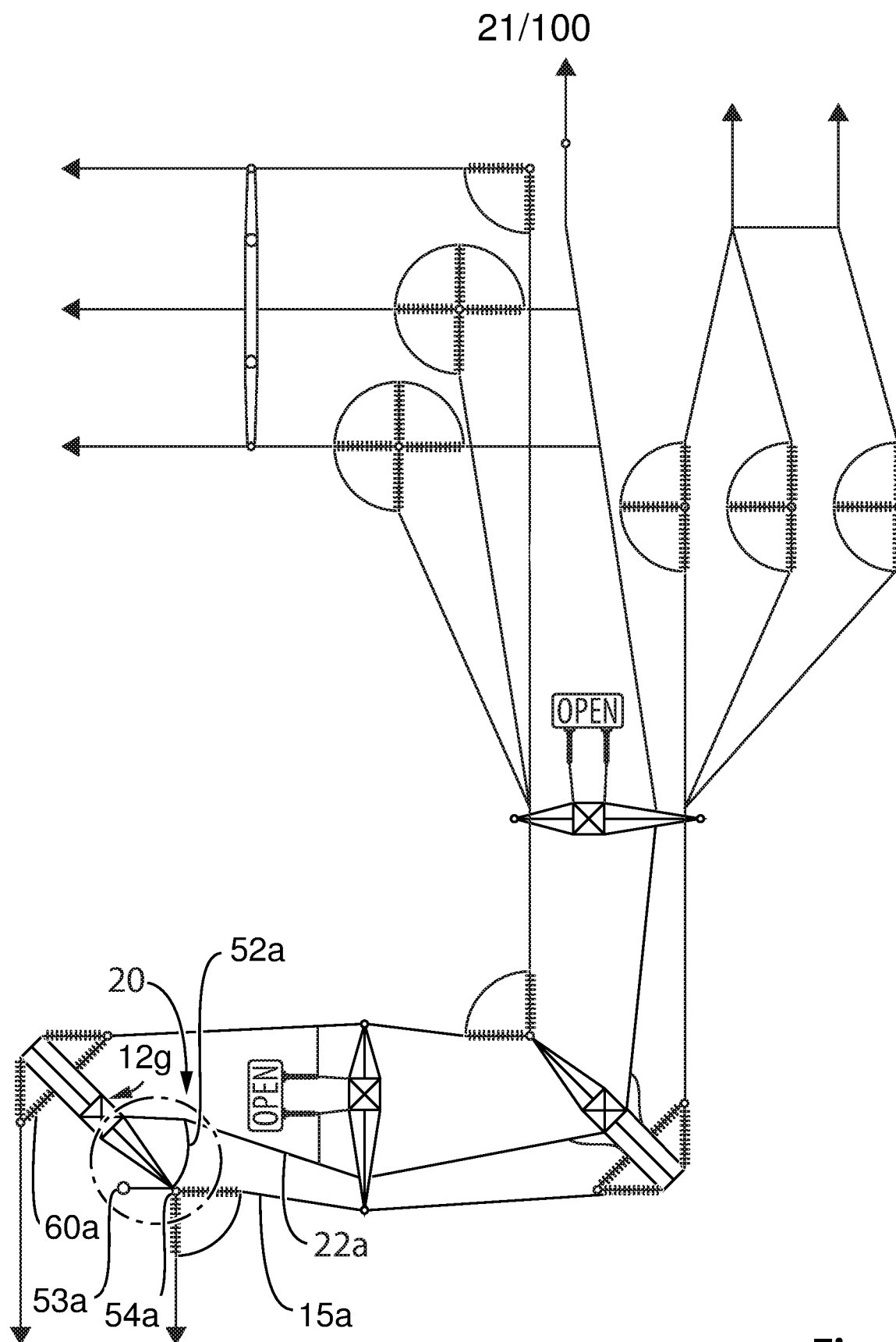


Fig. 11

22/100

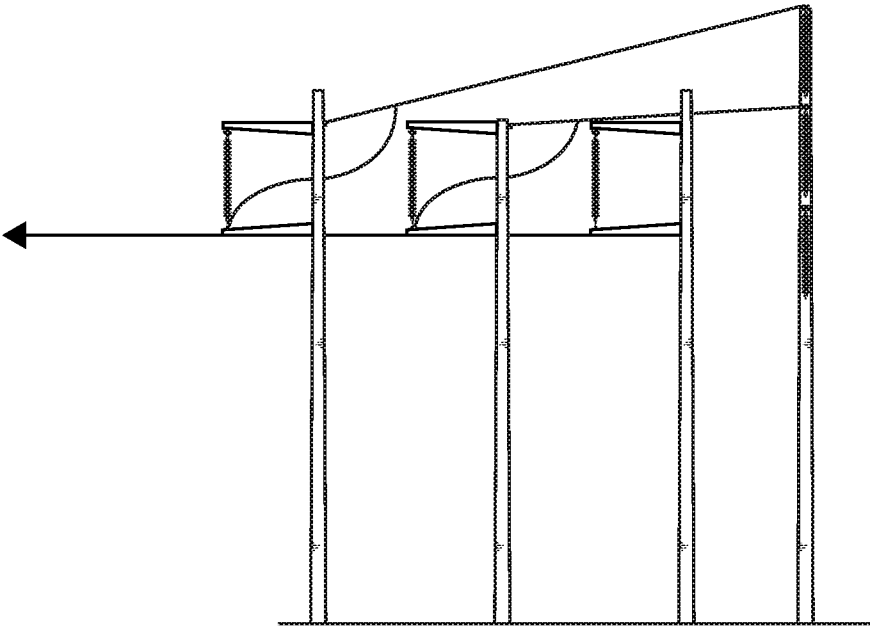


Fig. 11a

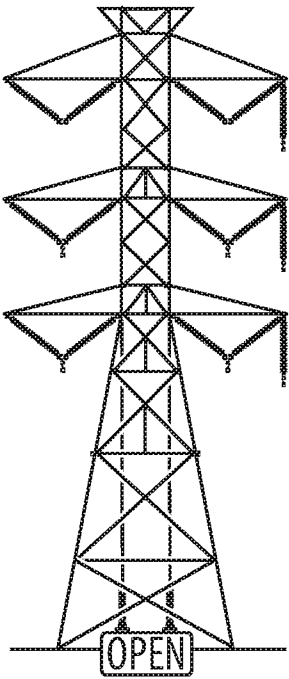


Fig. 11b

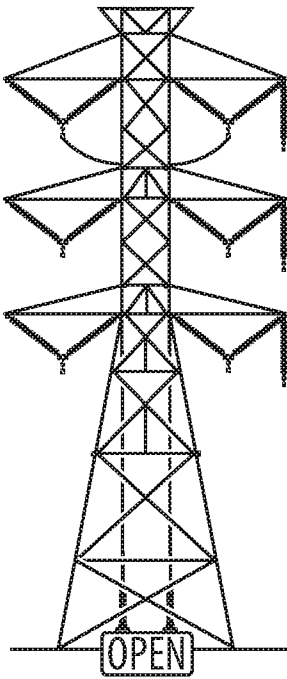


Fig. 11c

23/100

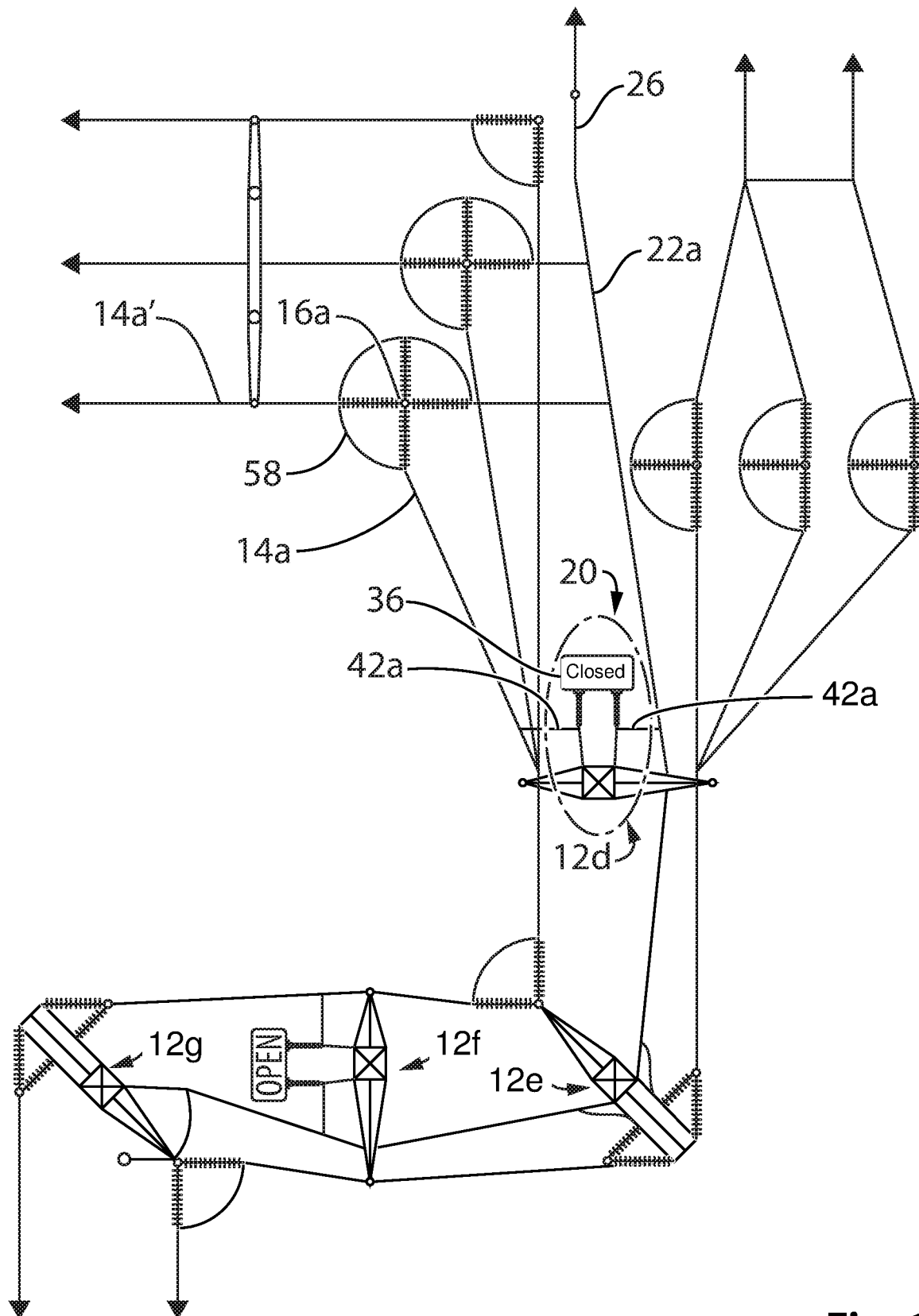


Fig. 12

24/100

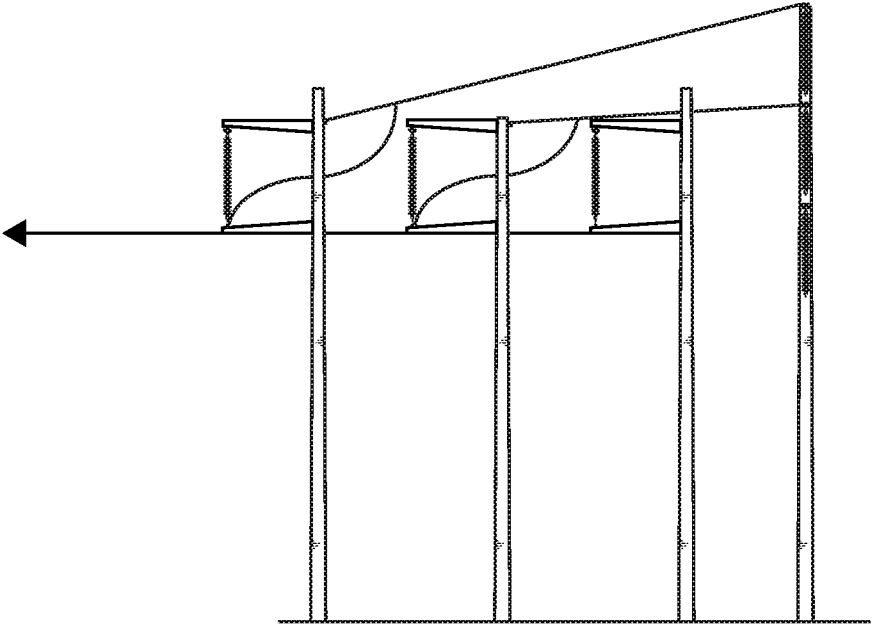


Fig. 12a

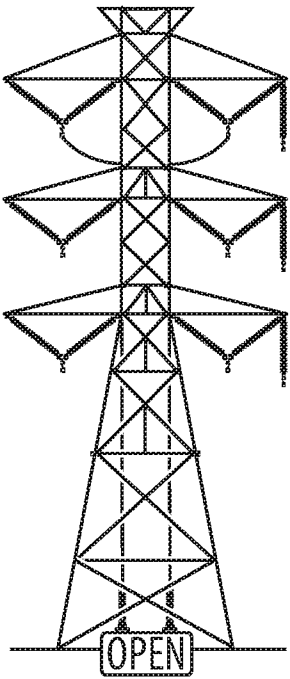


Fig. 12b

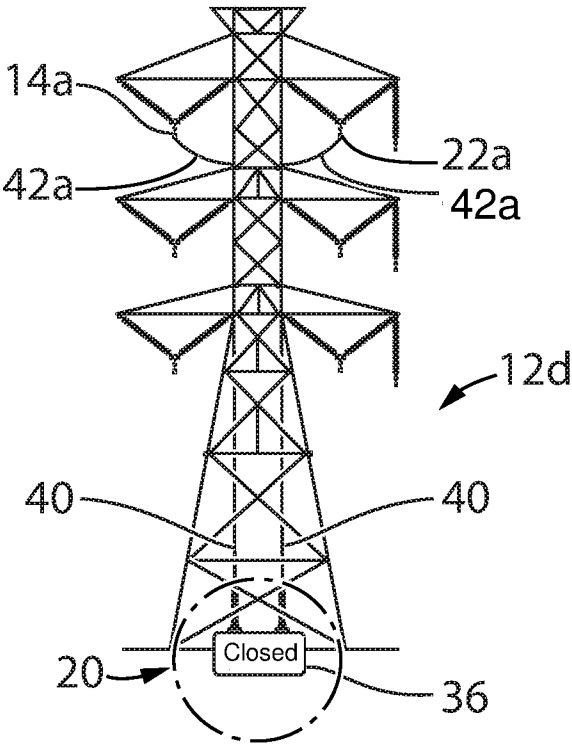


Fig. 12c

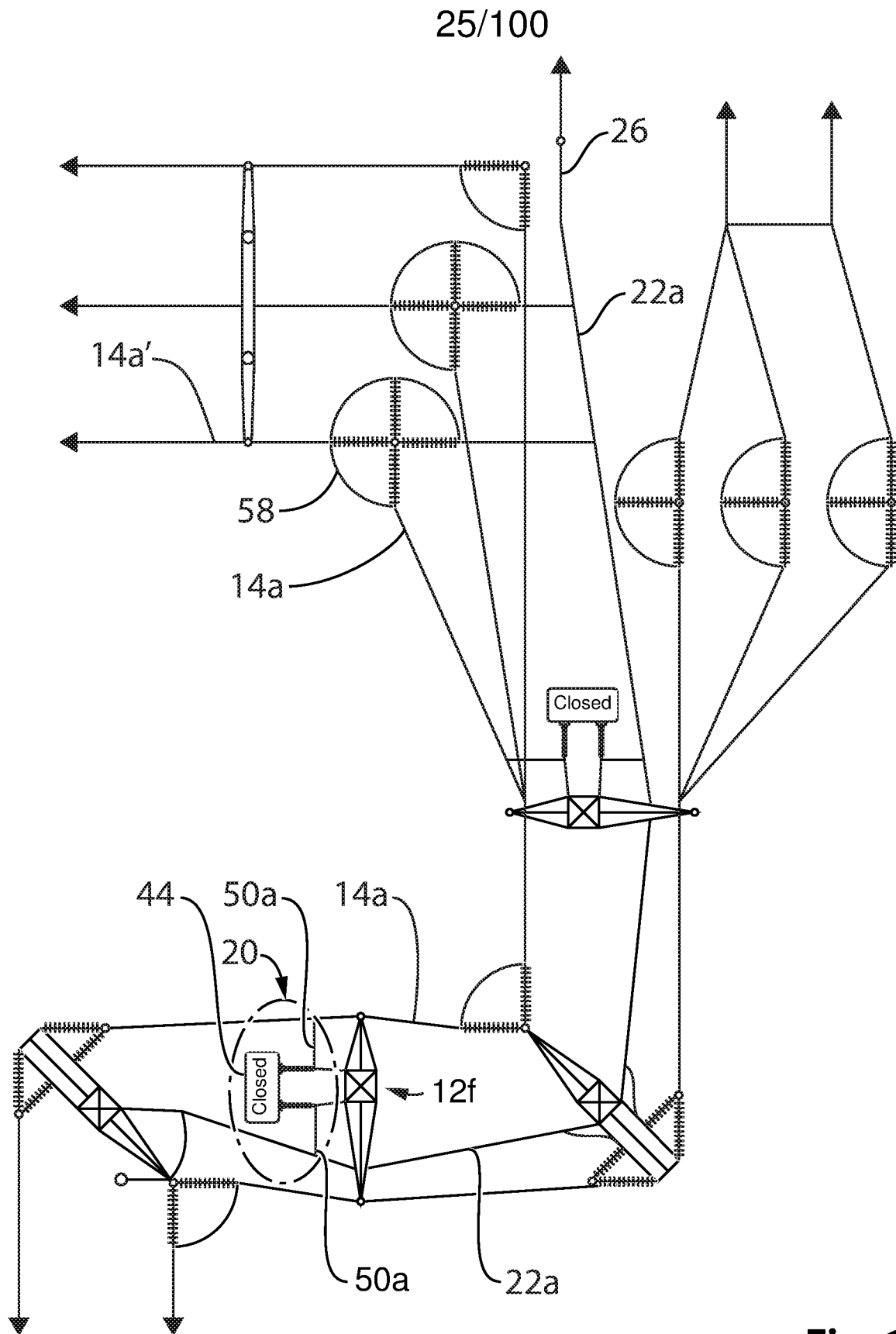


Fig. 13

26/100

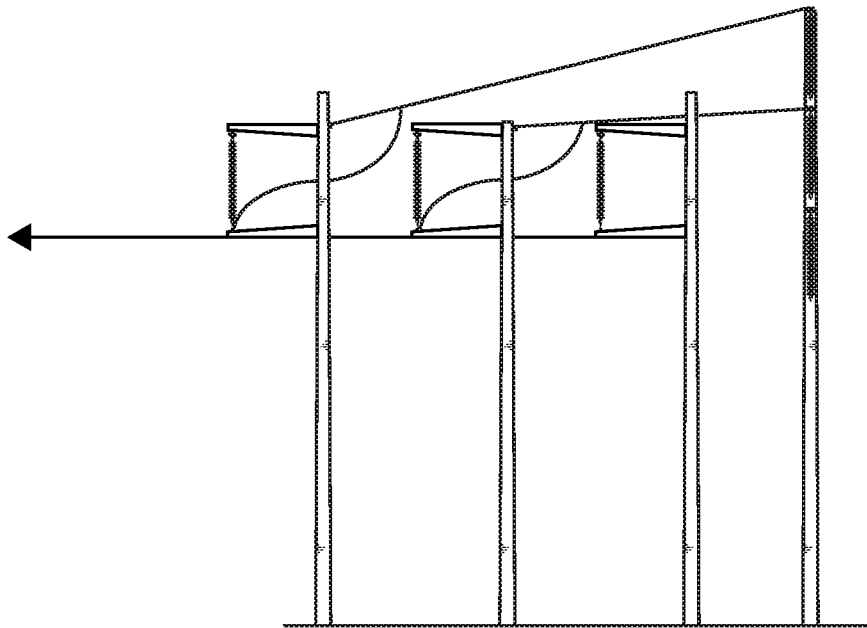


Fig. 13a

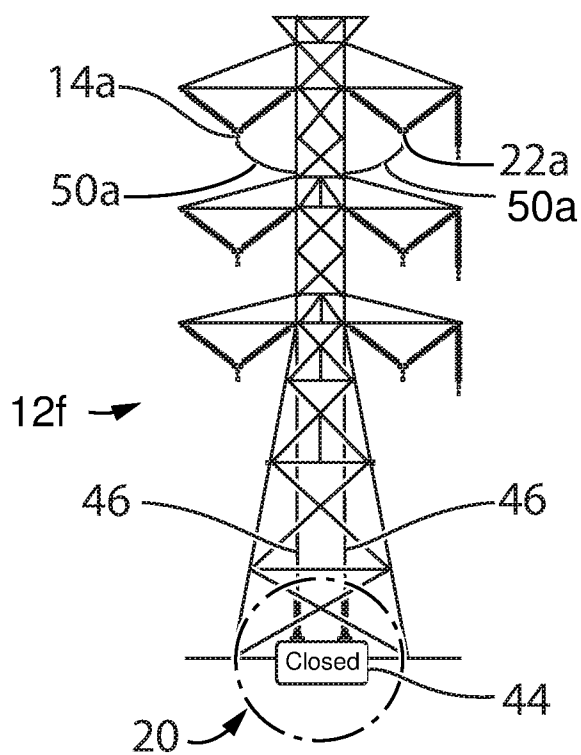


Fig. 13b

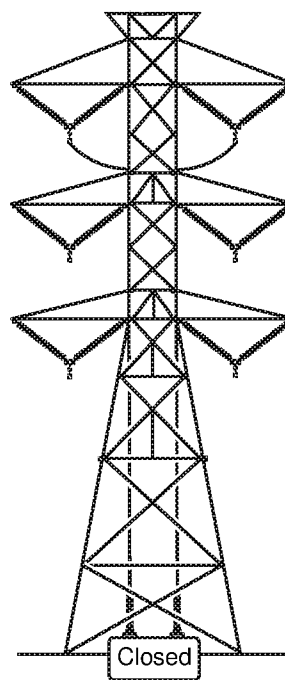


Fig. 13c

27/100

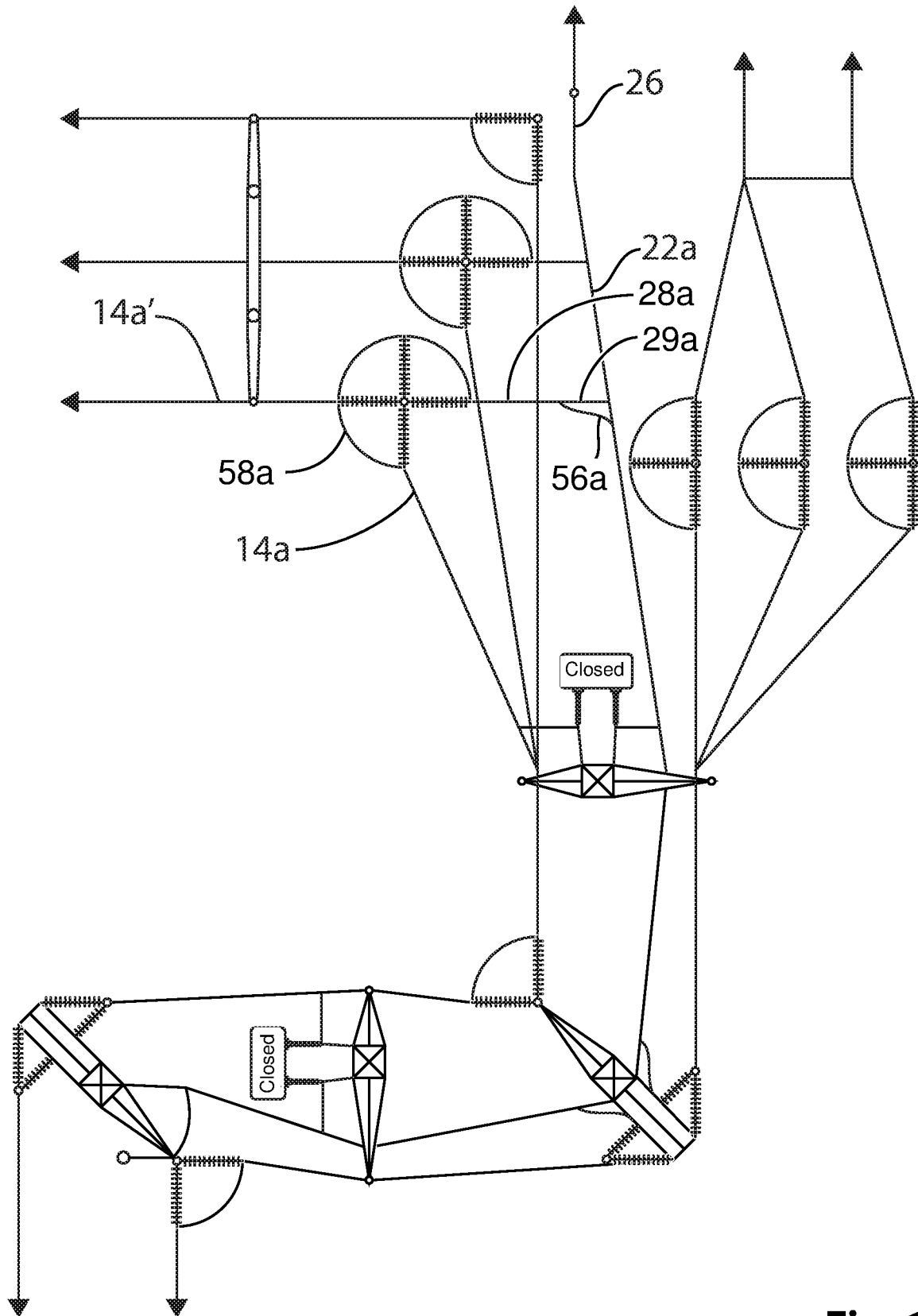


Fig. 14

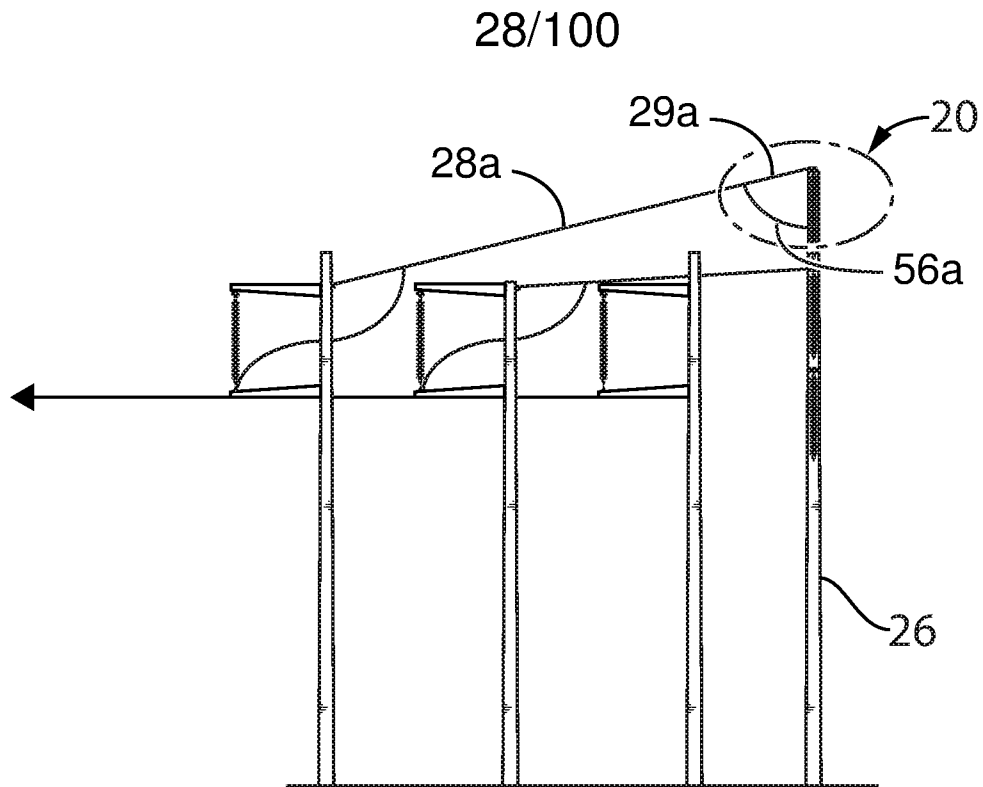


Fig. 14a

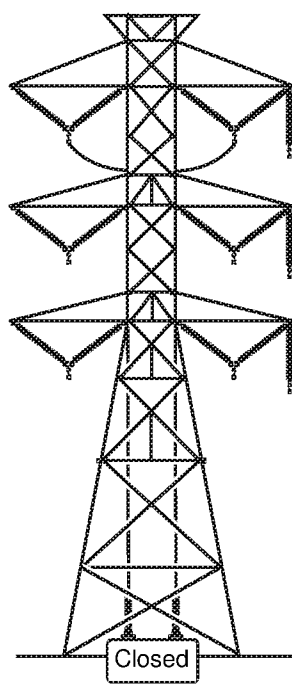


Fig. 14b

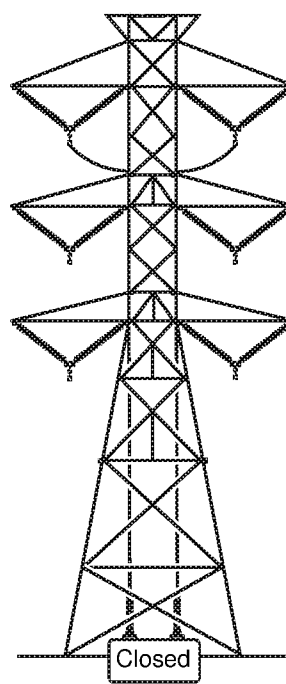


Fig. 14c

29/100

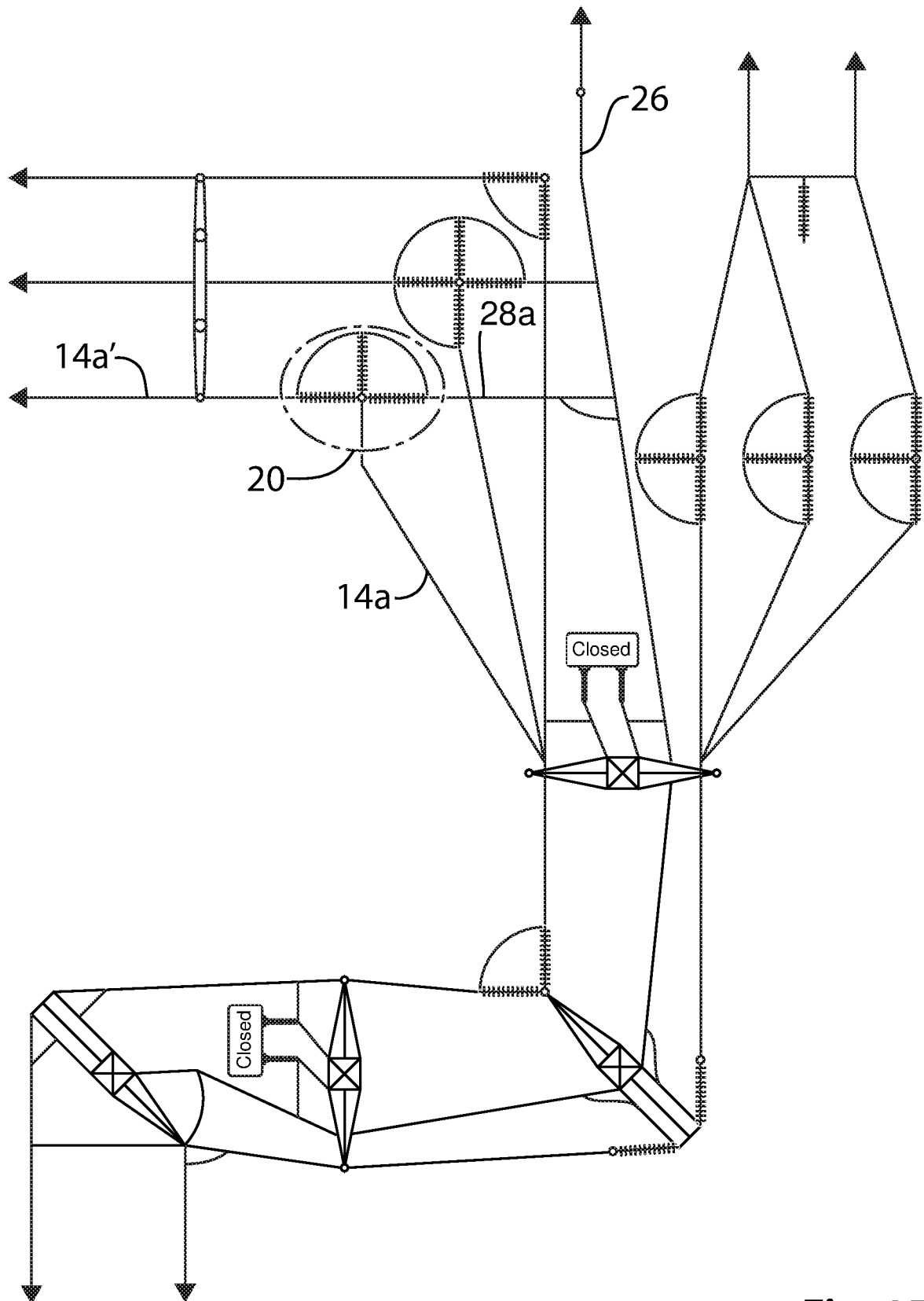


Fig. 15

30/100

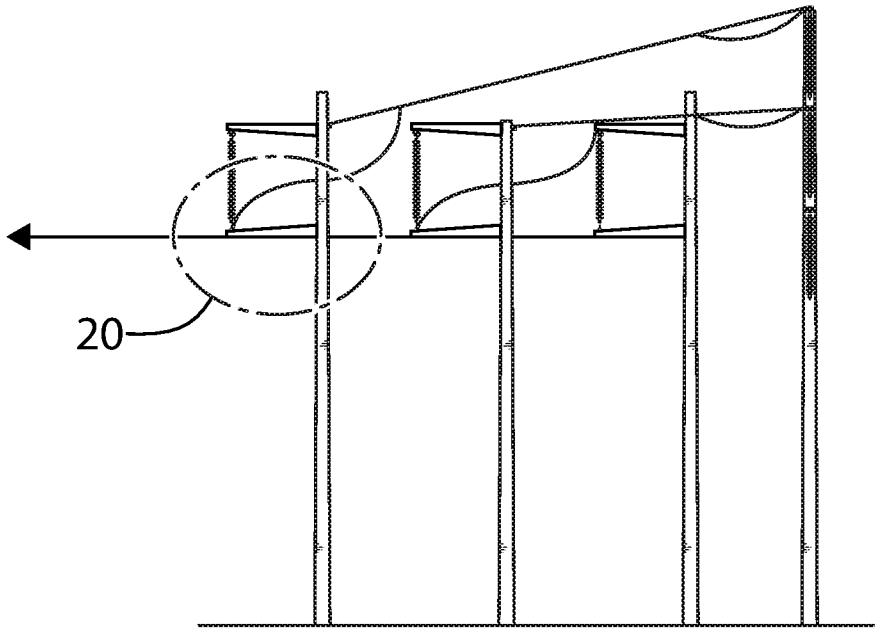


Fig. 15a

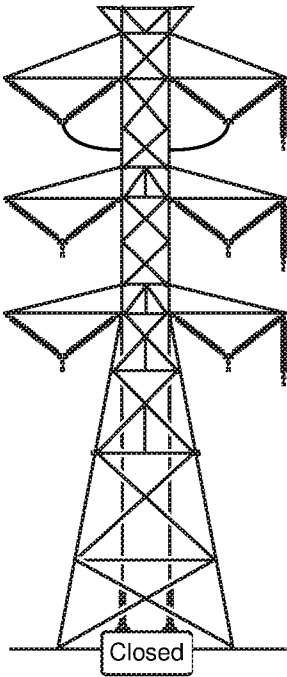


Fig. 15b

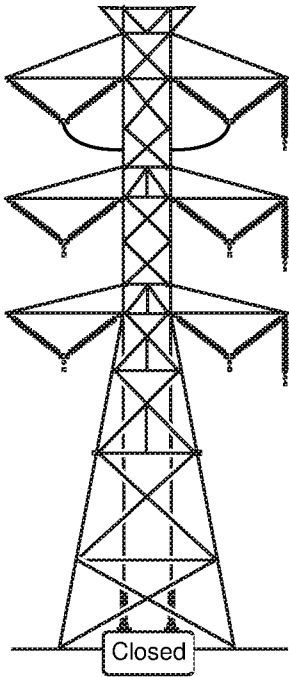


Fig. 15c

31/100

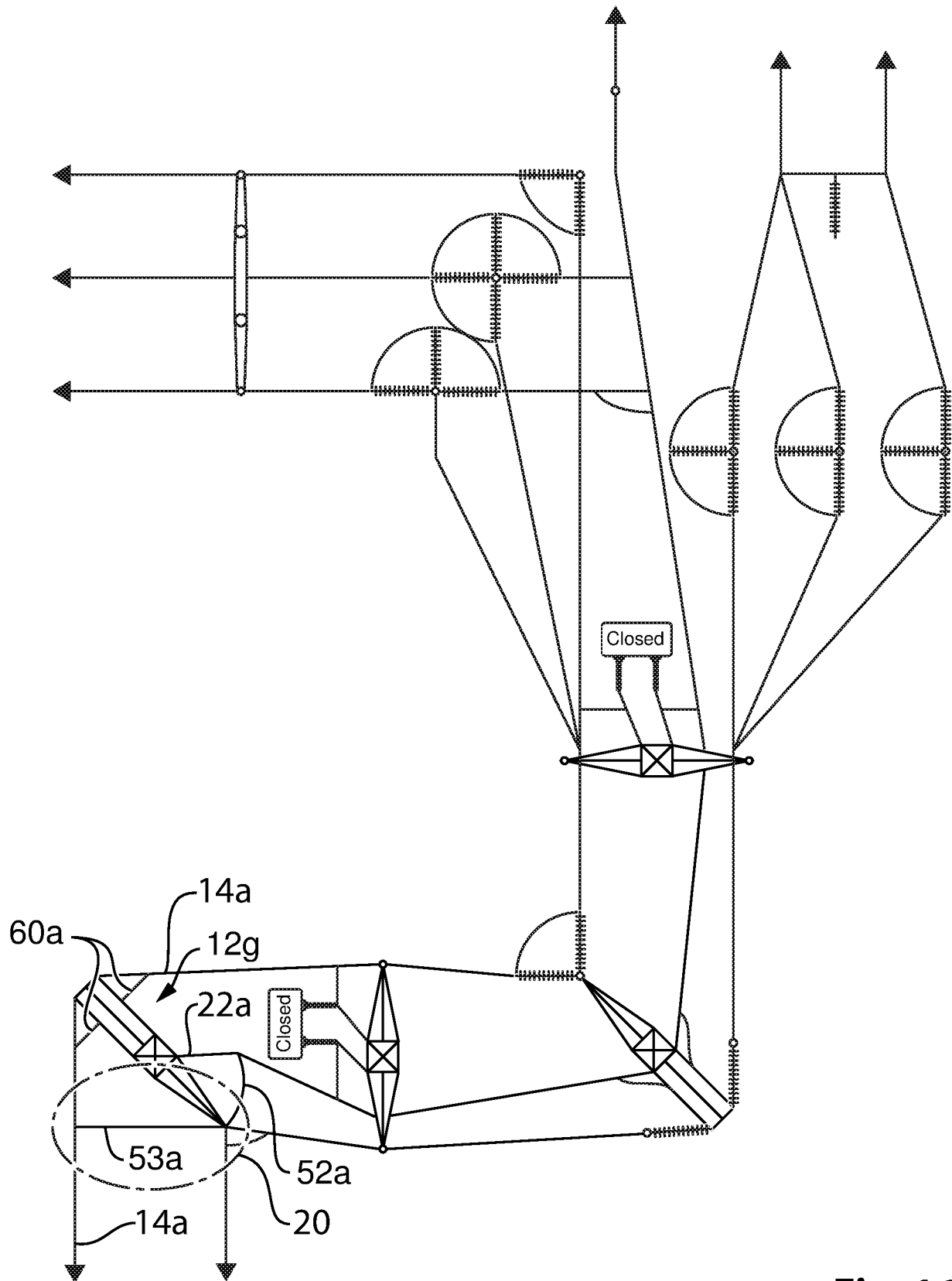


Fig. 16

32/100

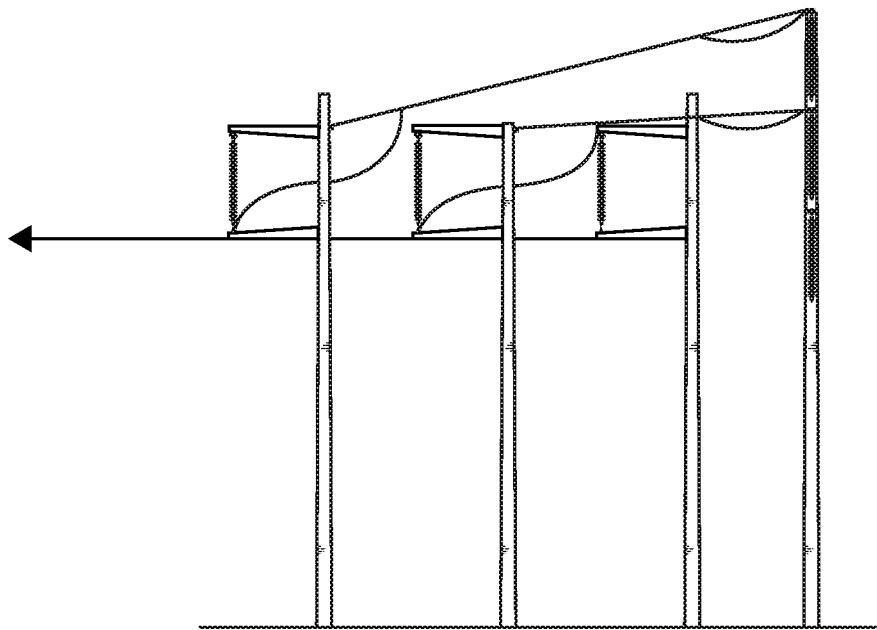


Fig. 16a

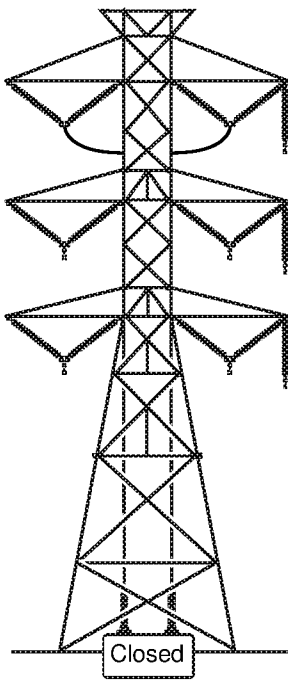


Fig. 16b

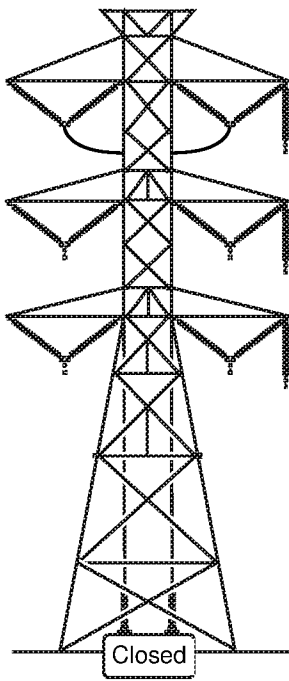


Fig. 16c

33/100

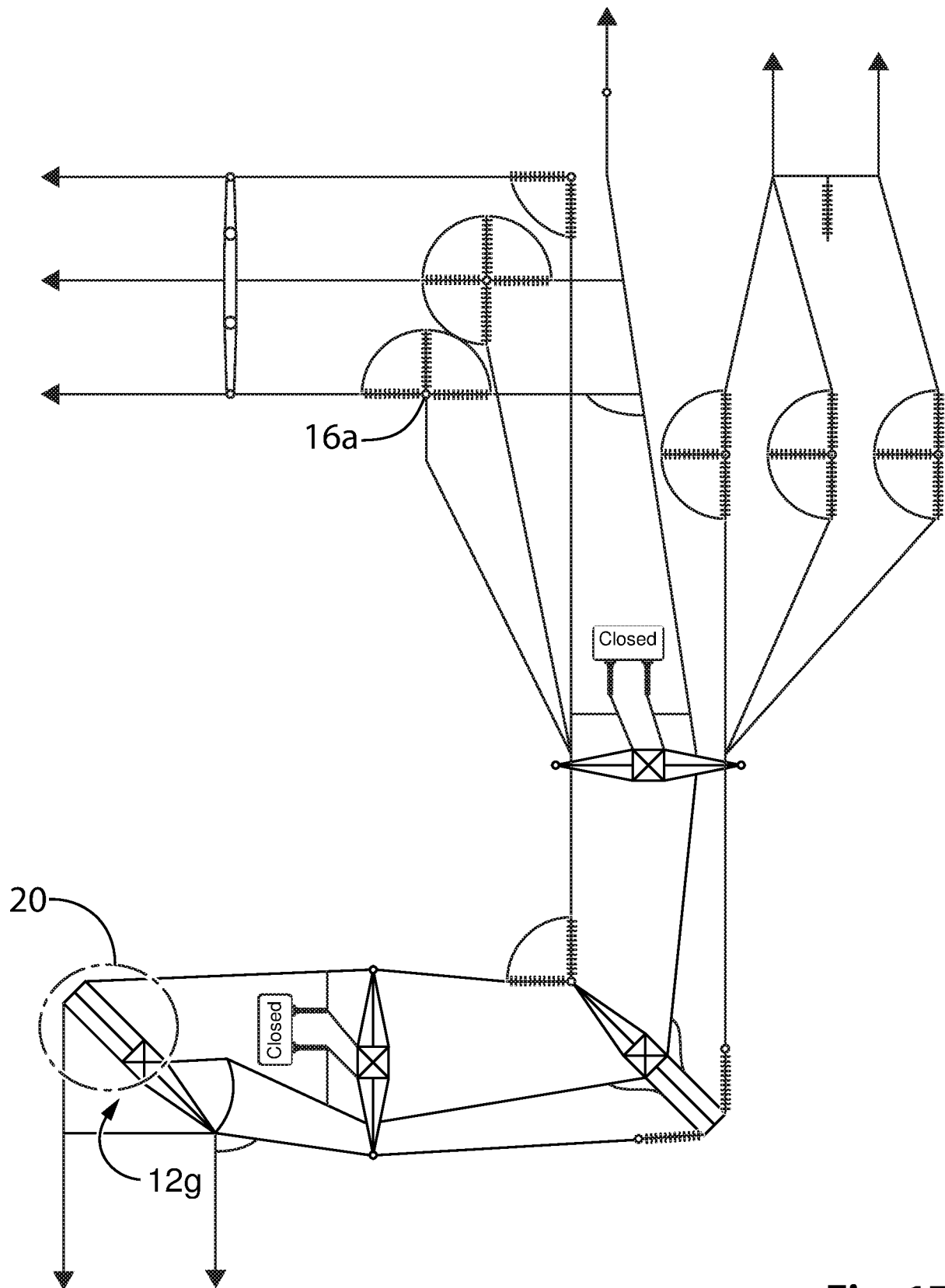


Fig. 17

34/100

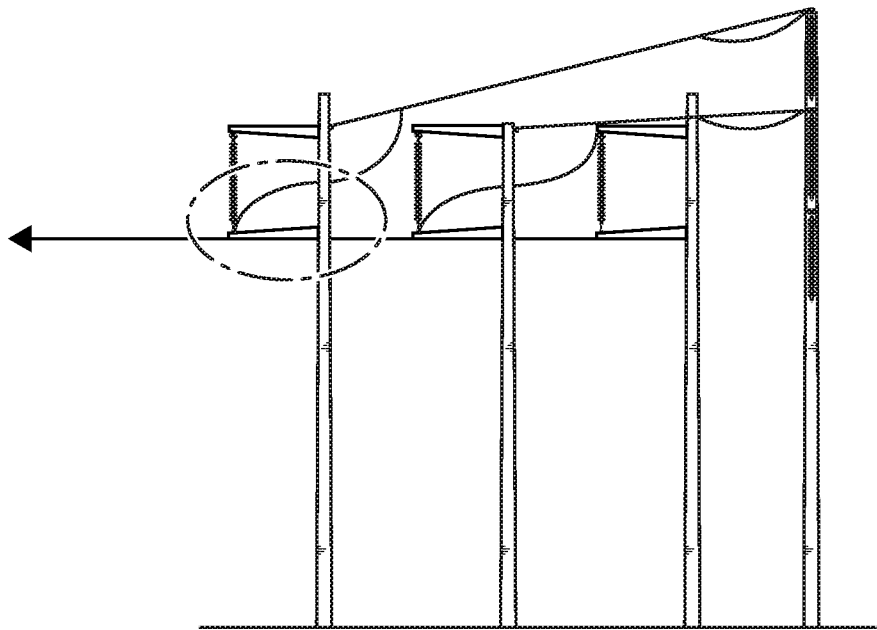


Fig. 17a

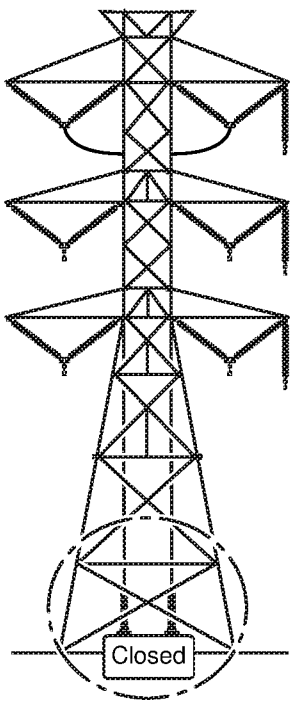


Fig. 17b

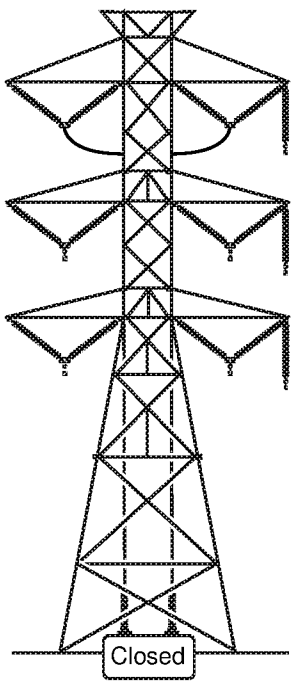


Fig. 17c

35/100

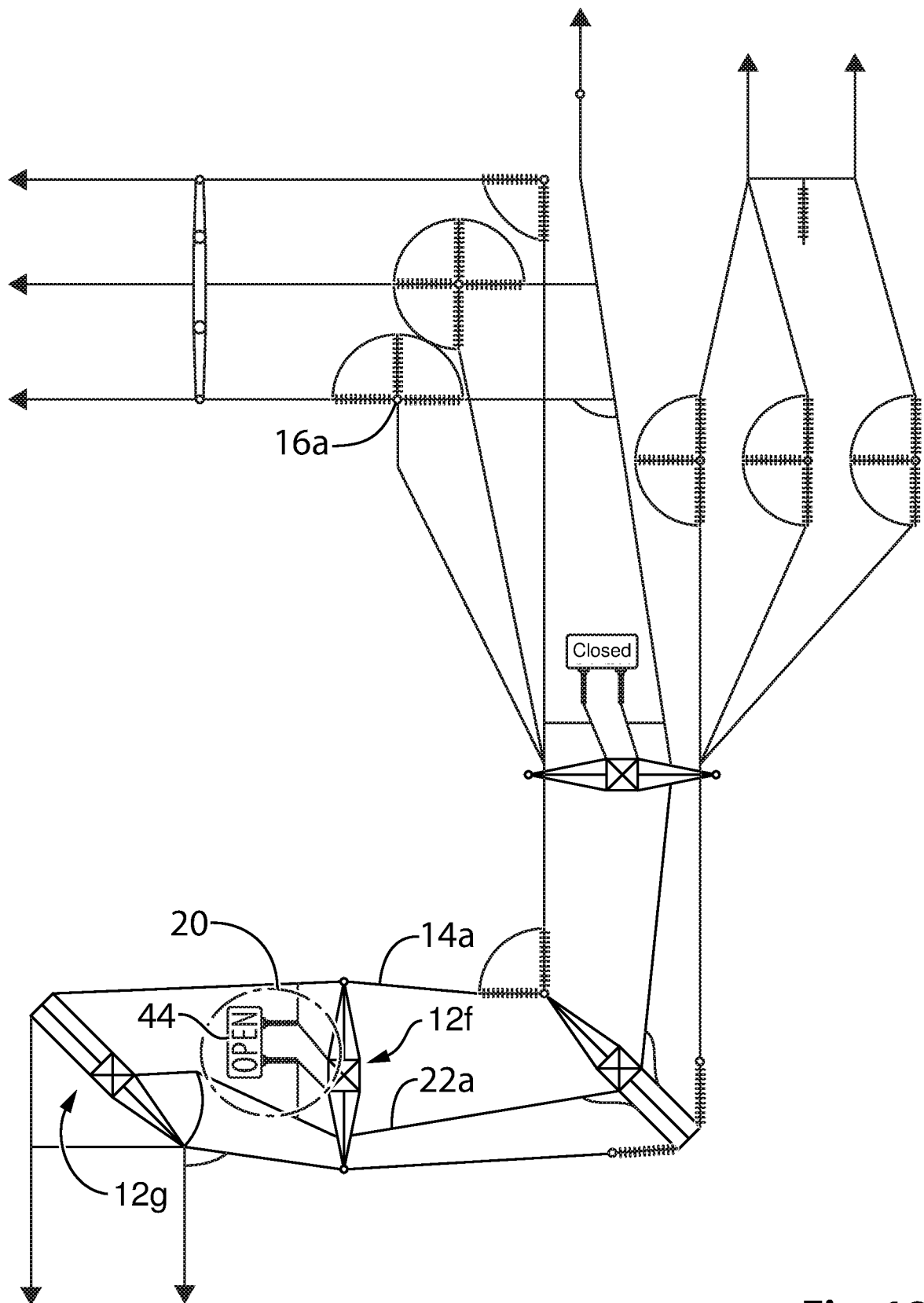


Fig. 18

36/100

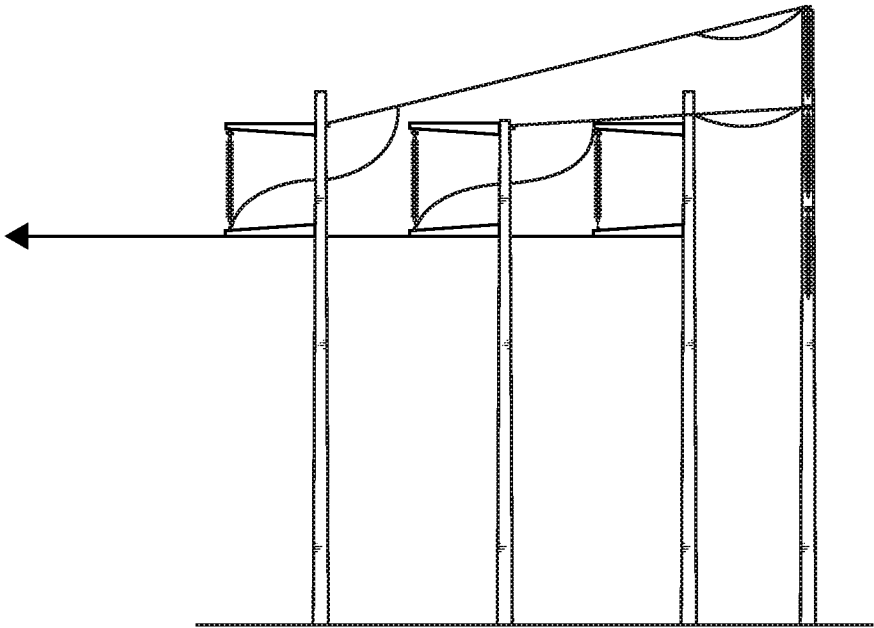


Fig. 18a

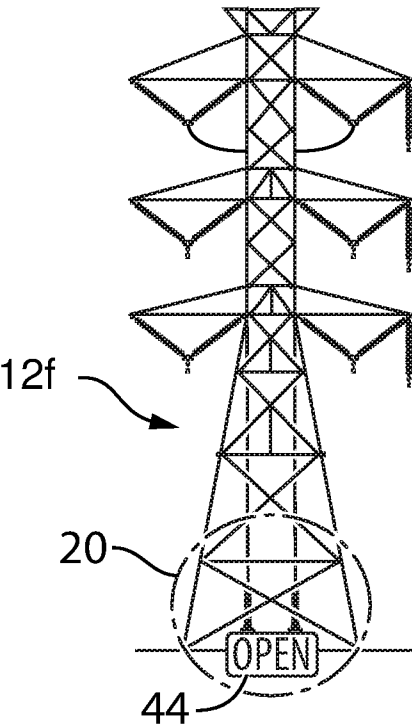


Fig. 18b

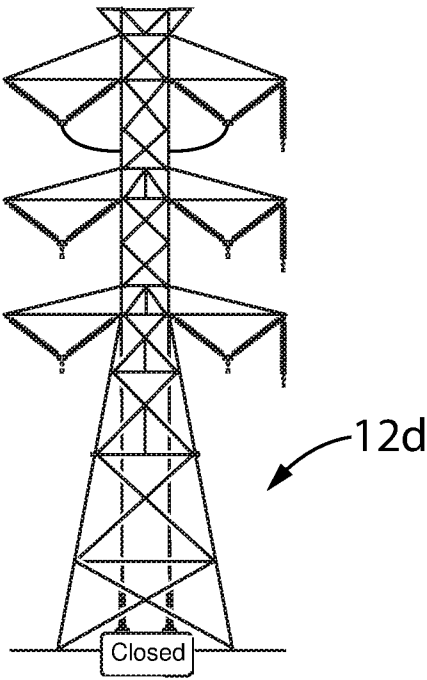


Fig. 18c

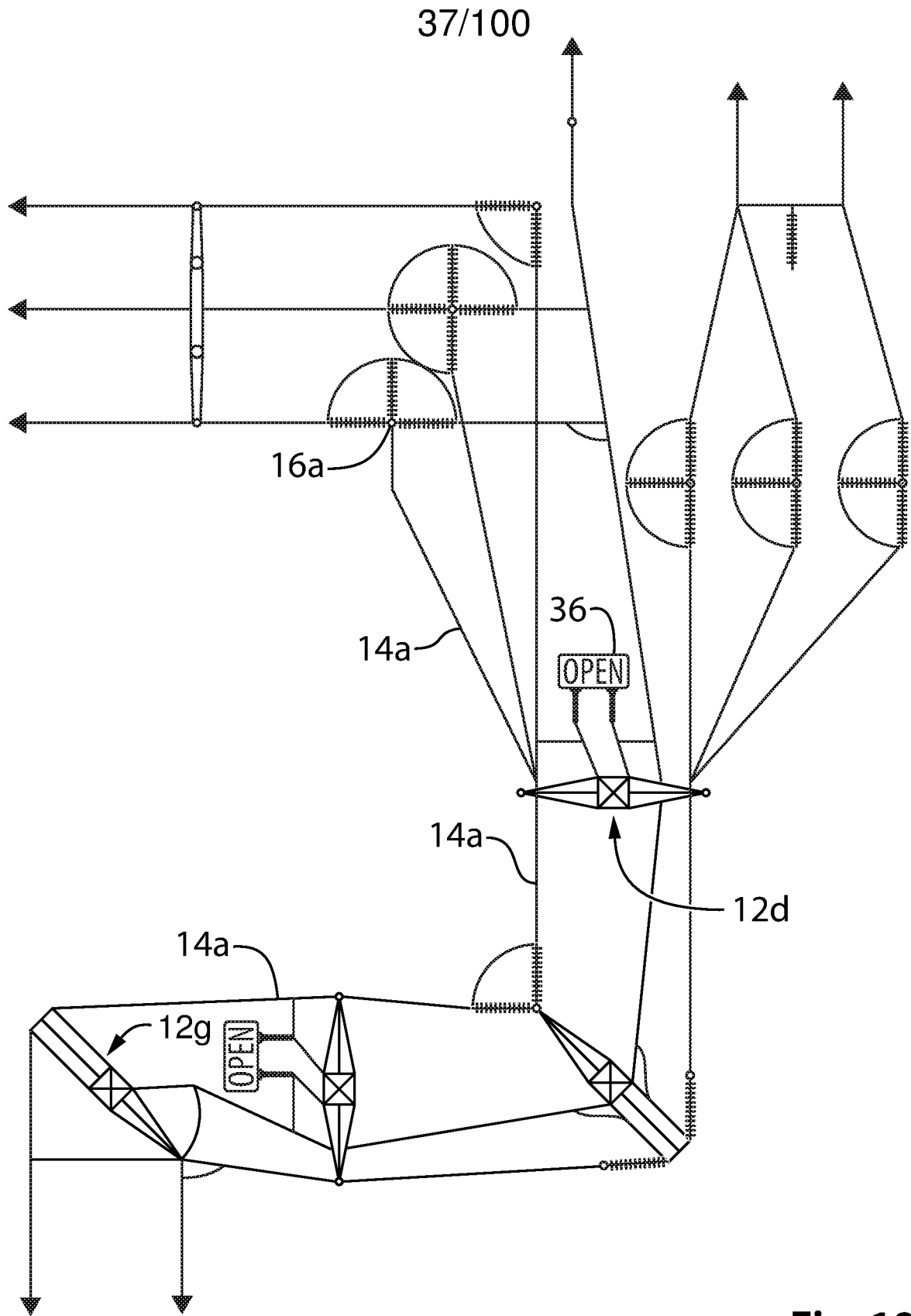


Fig. 19

38/100

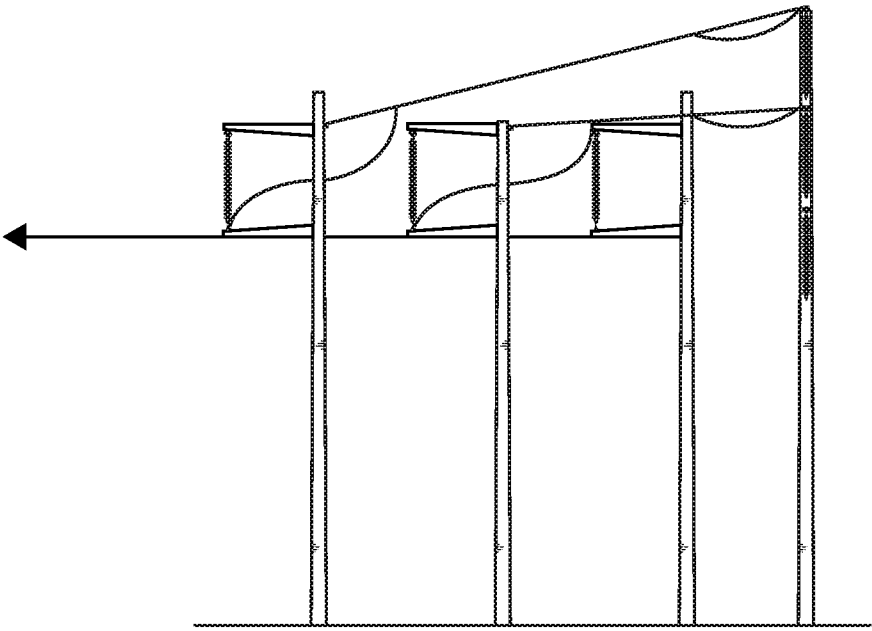


Fig. 19a

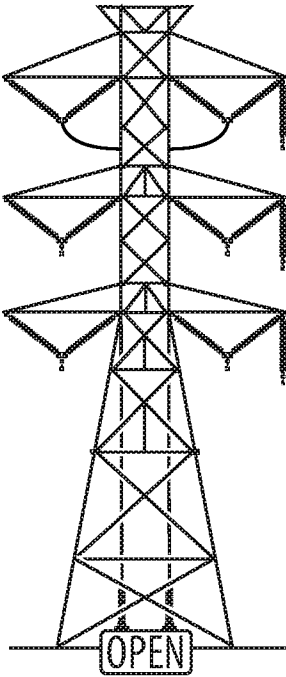


Fig. 19b

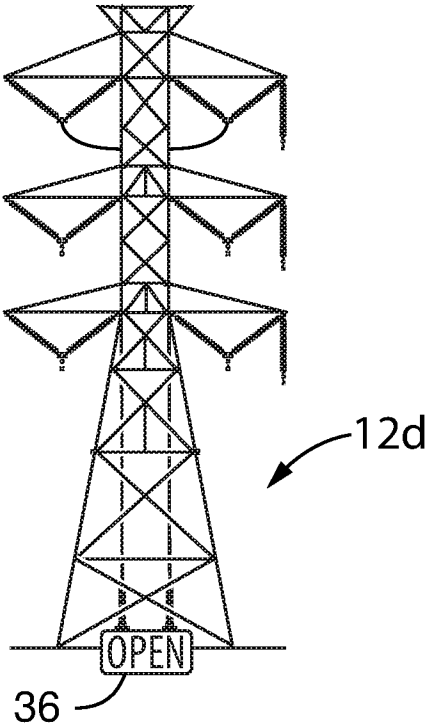


Fig. 19c

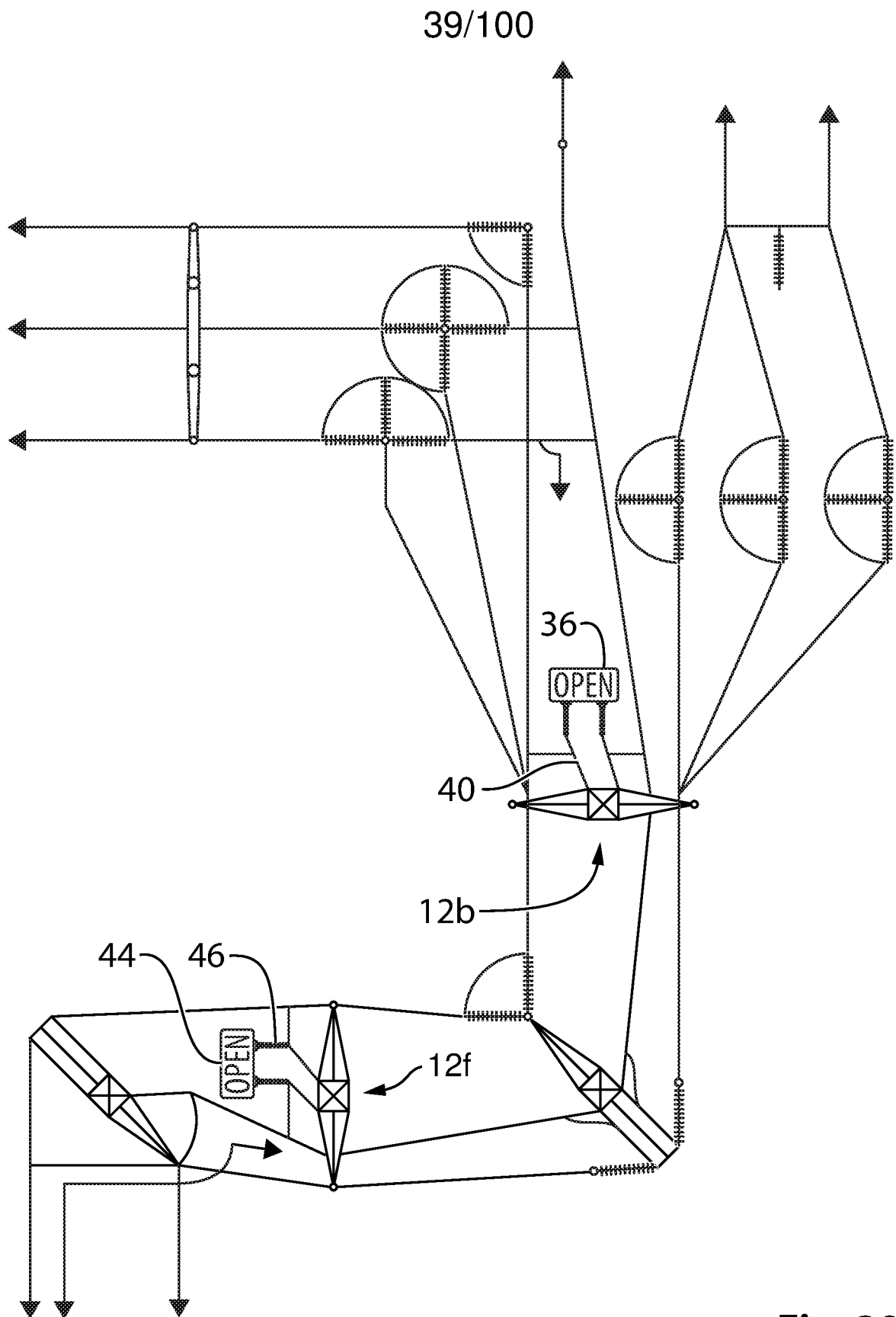


Fig. 20

40/100

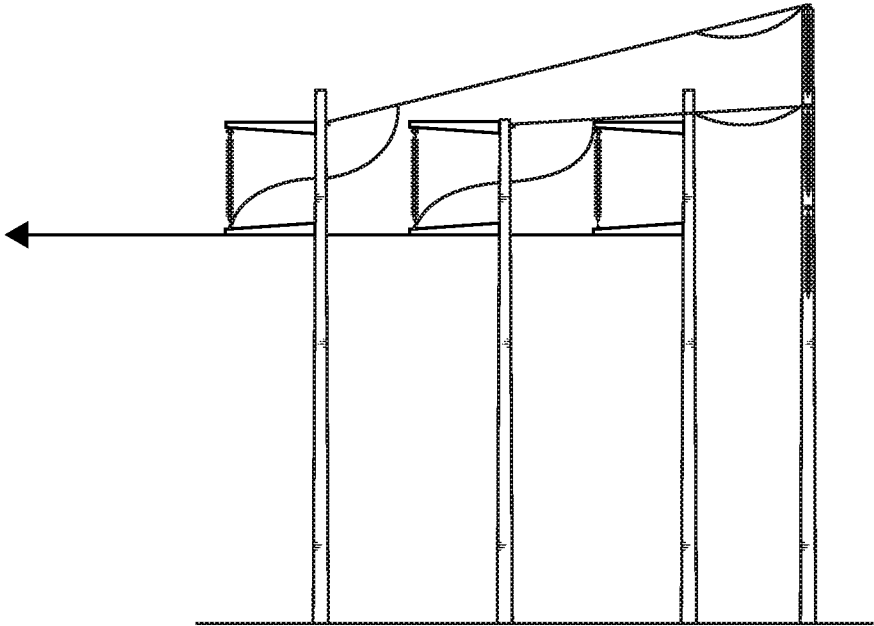


Fig. 20a

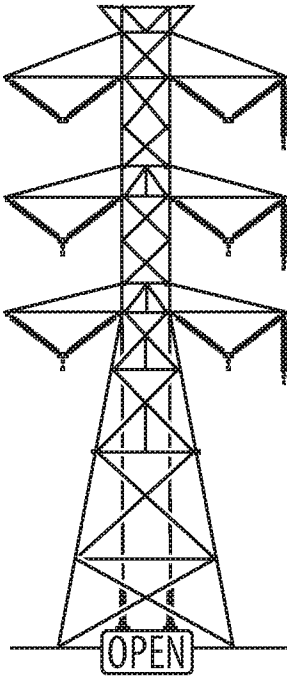


Fig. 20b

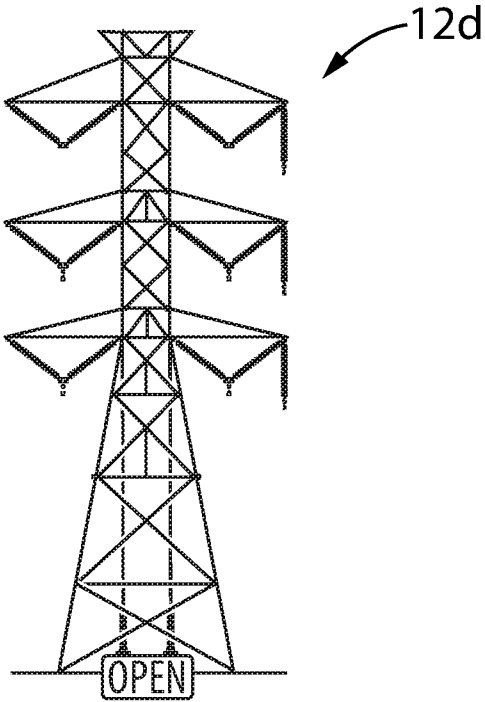


Fig. 20c

41/100

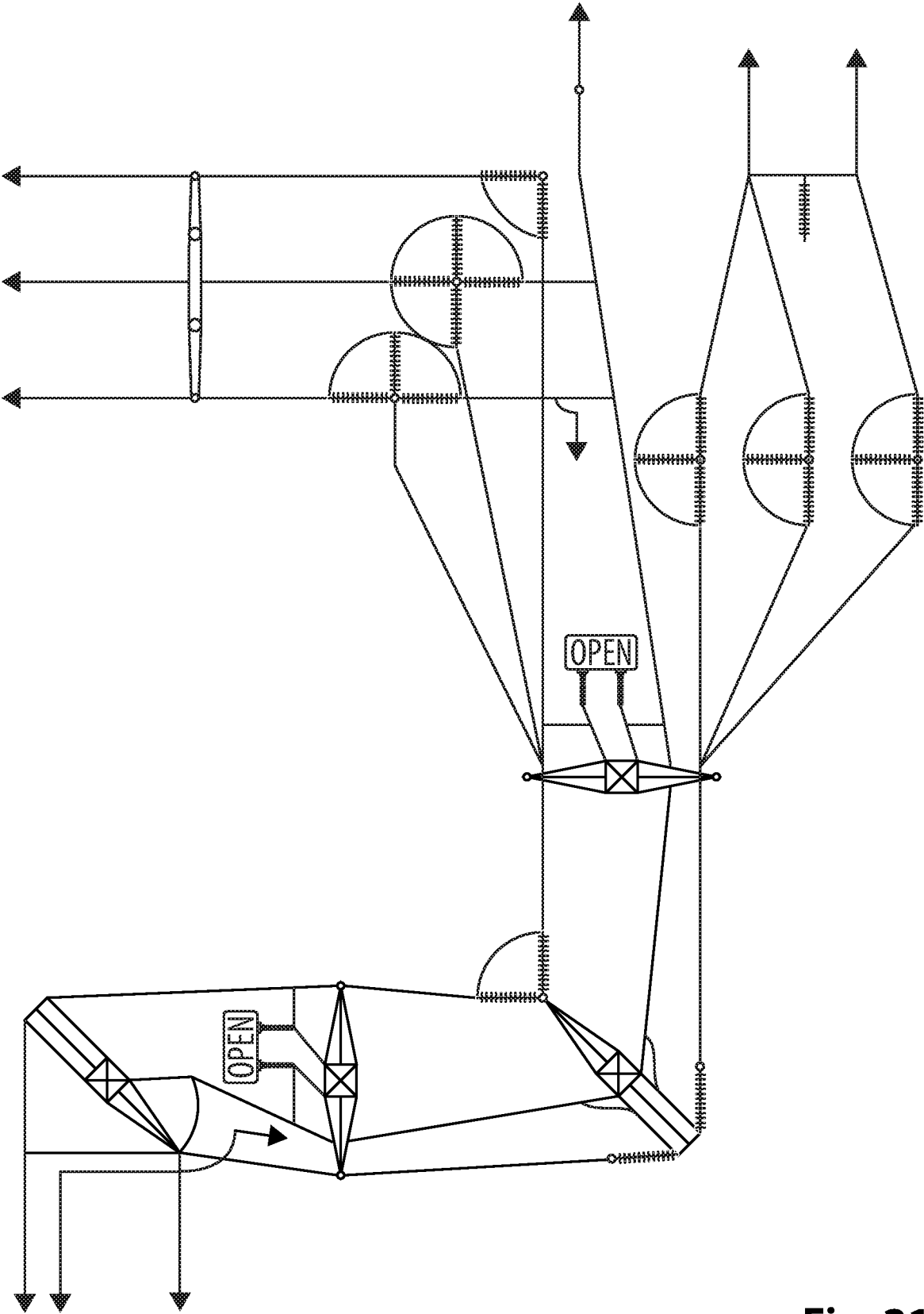


Fig. 21

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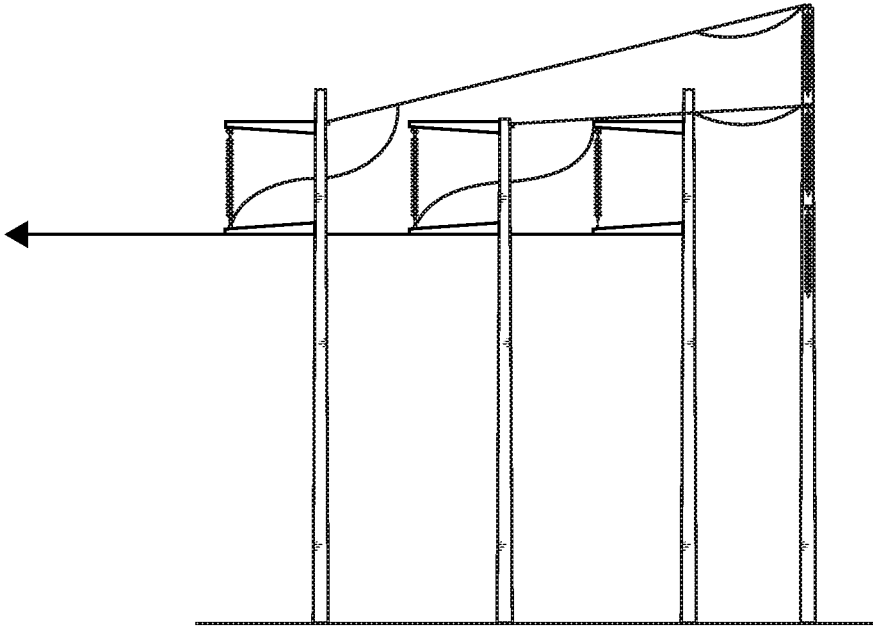


Fig. 21a

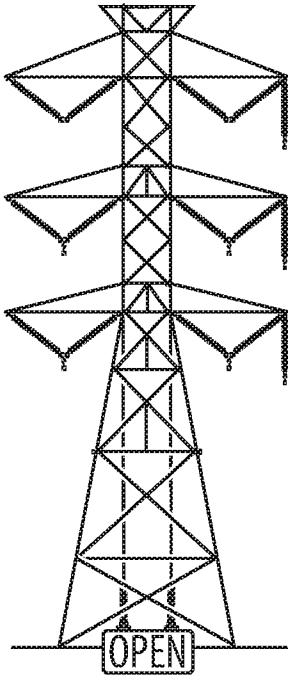


Fig. 21b

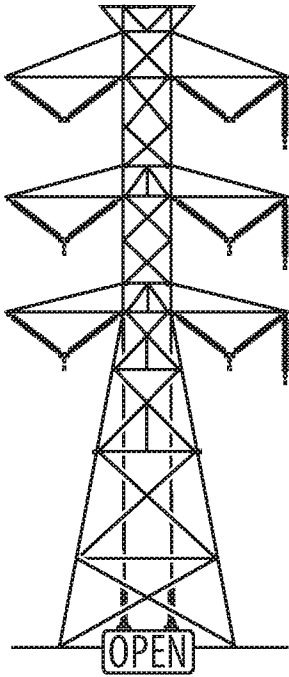


Fig. 21c

43/100

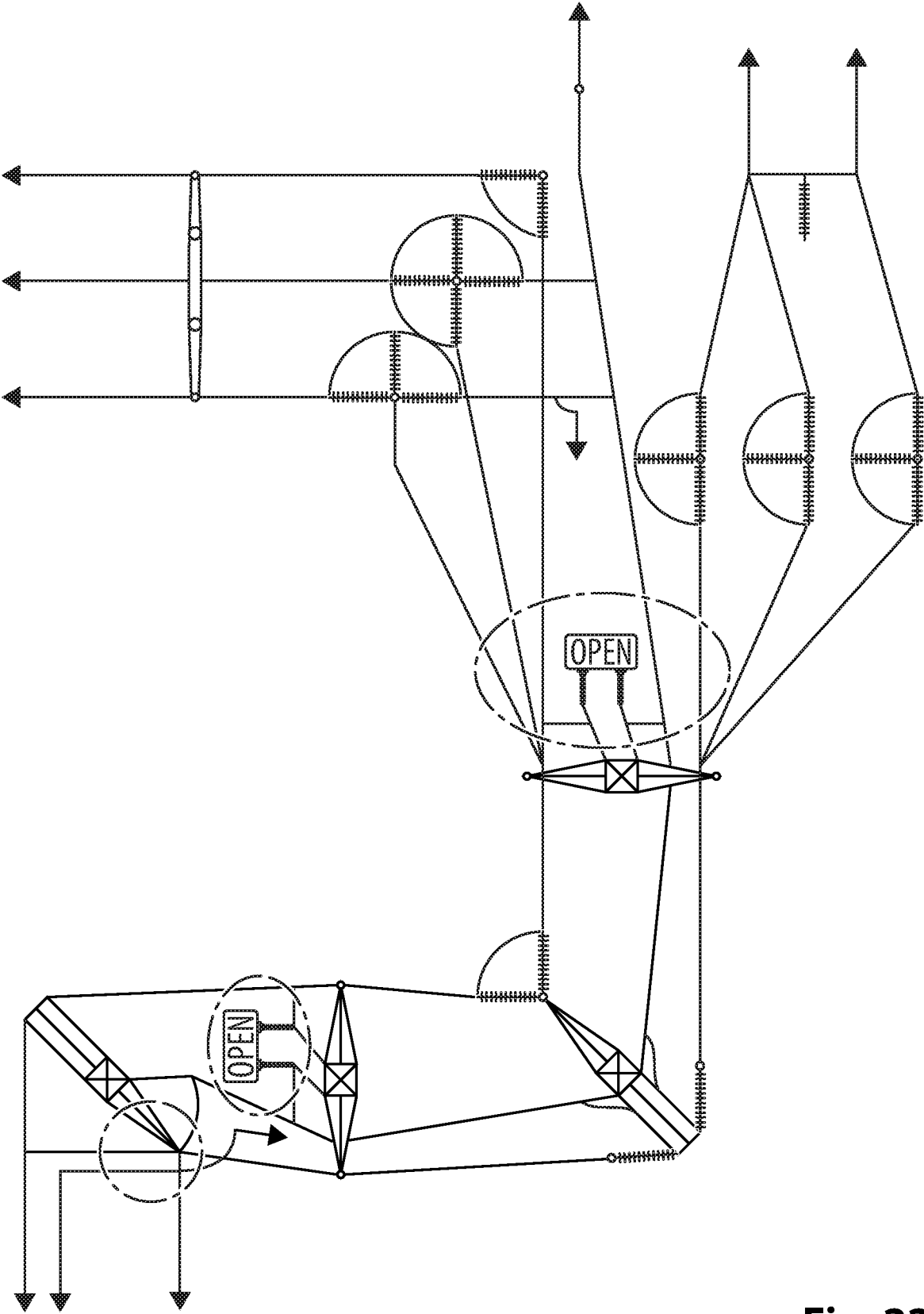


Fig. 22

44/100

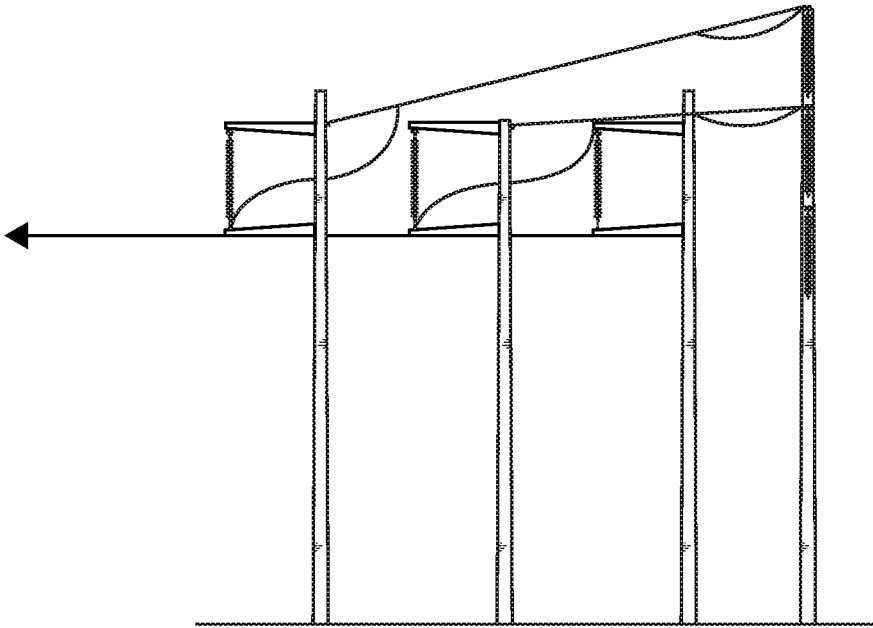


Fig. 22a

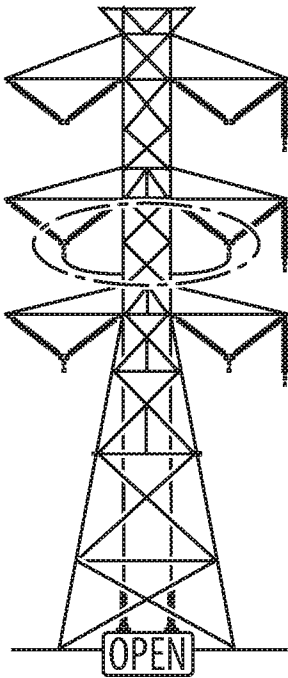


Fig. 22b

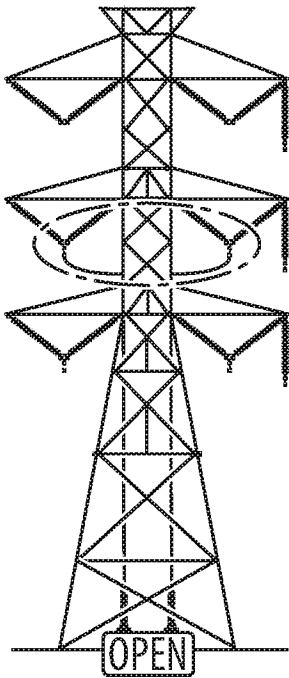


Fig. 22c

45/100

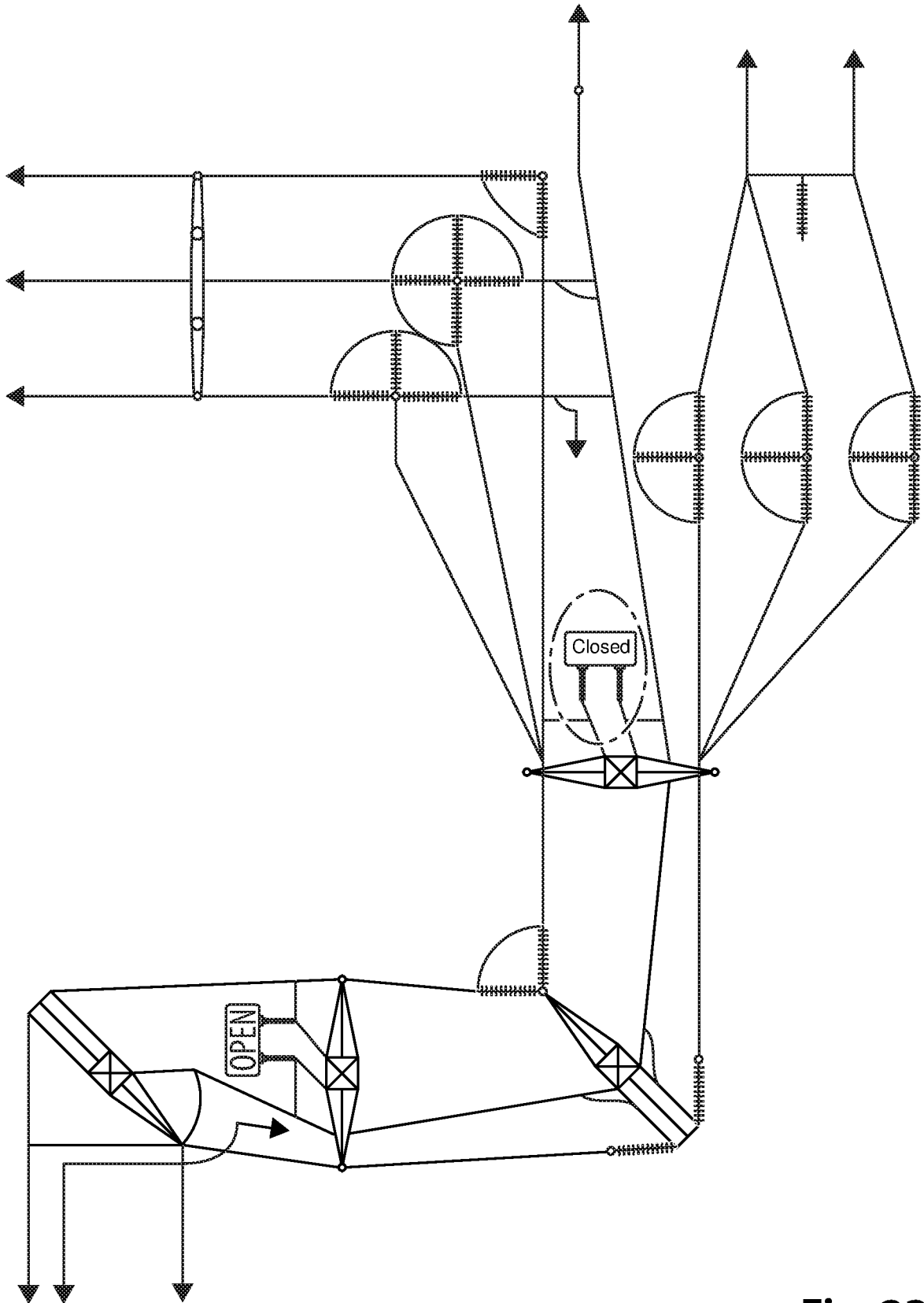


Fig. 23

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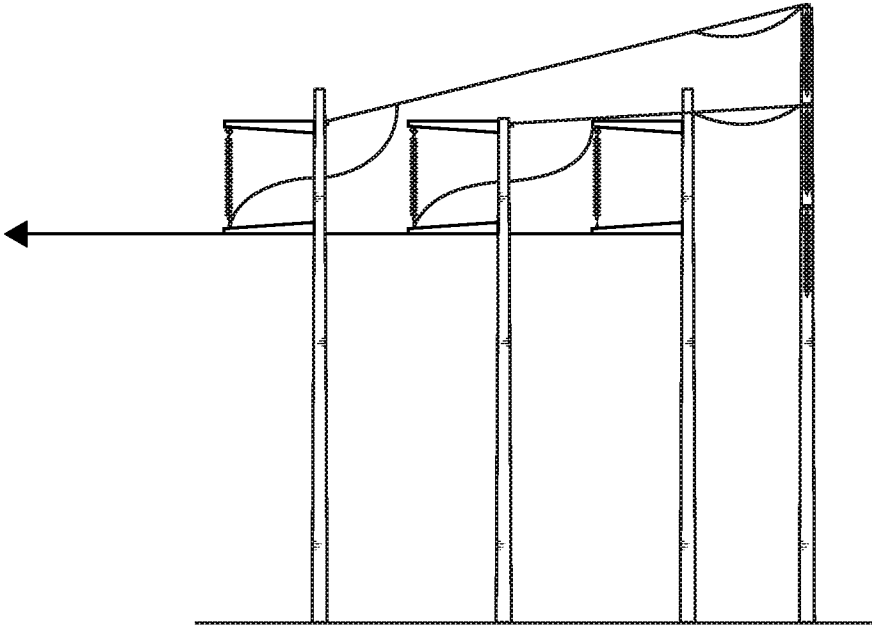


Fig. 23a

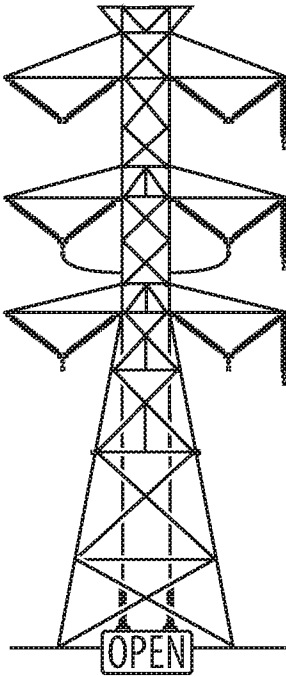


Fig. 23b

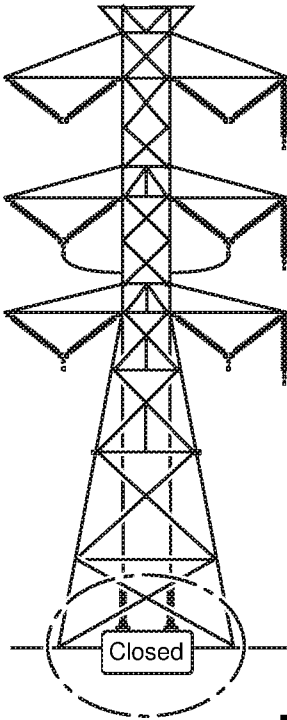


Fig. 23c

47/100

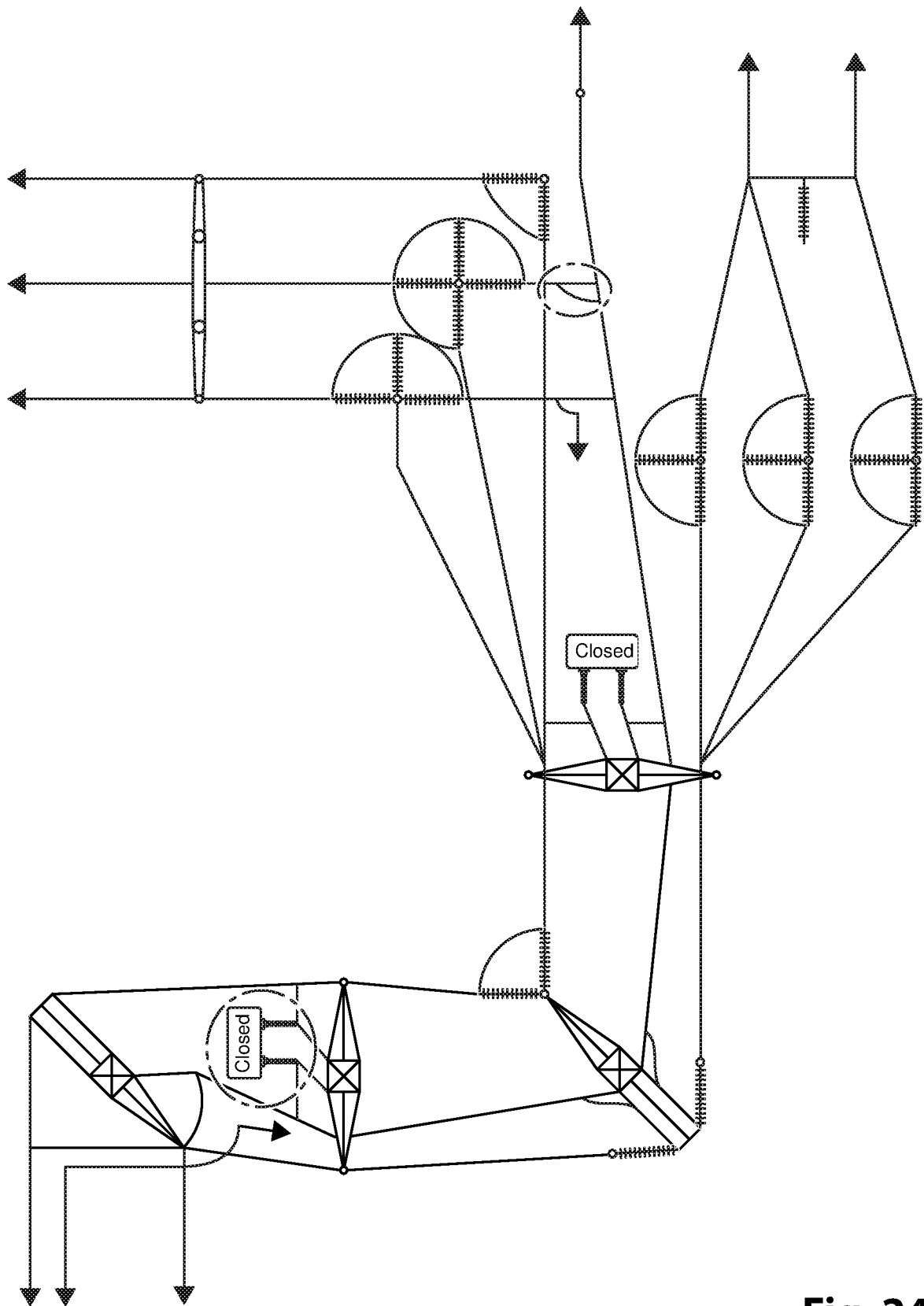


Fig. 24

48/100

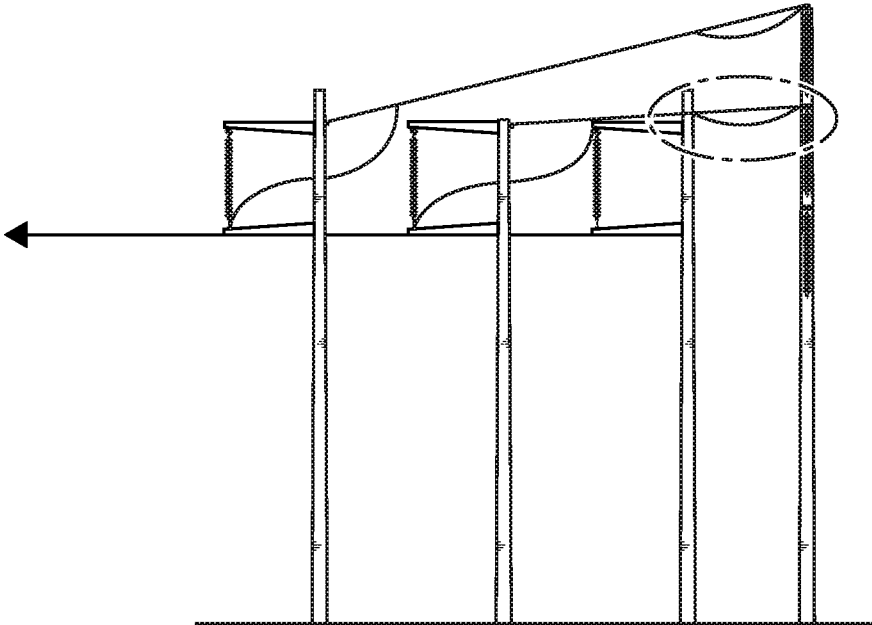


Fig. 24a

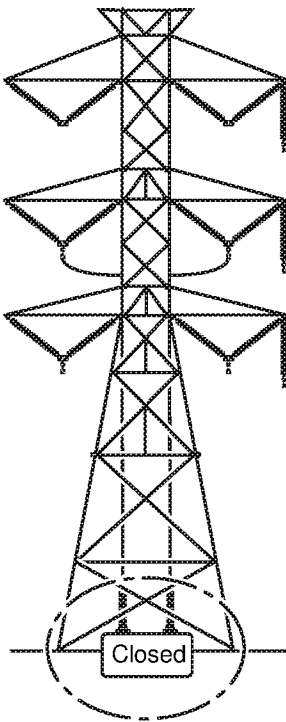


Fig. 24b

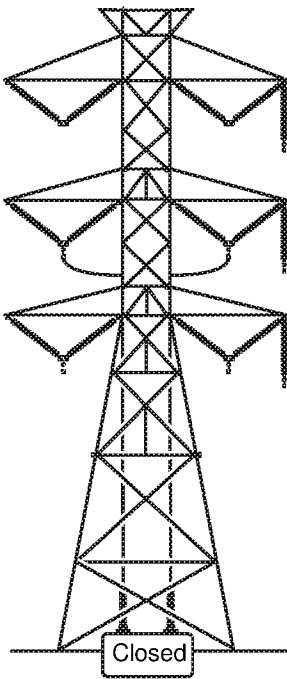


Fig. 24c

49/100

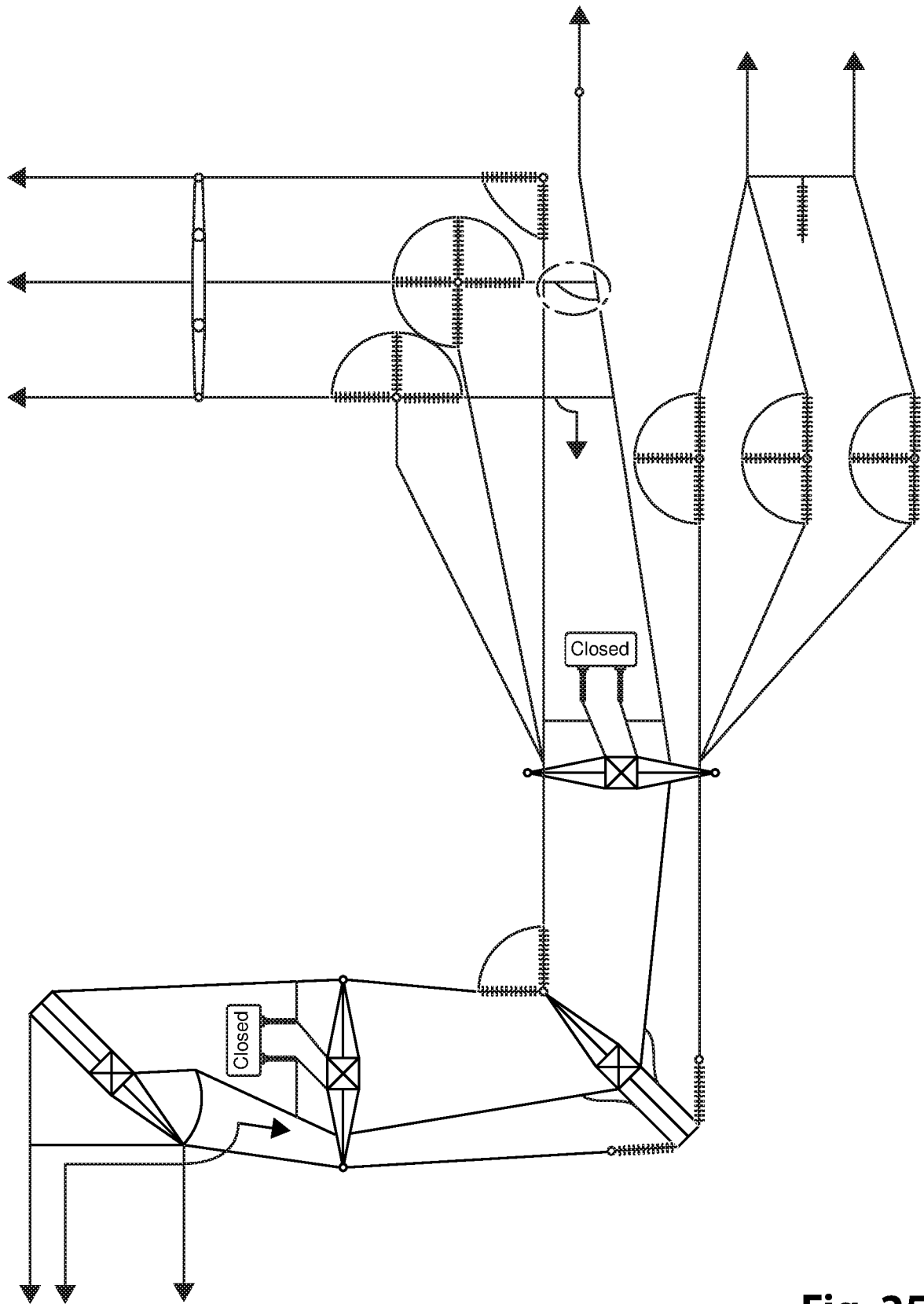


Fig. 25

50/100

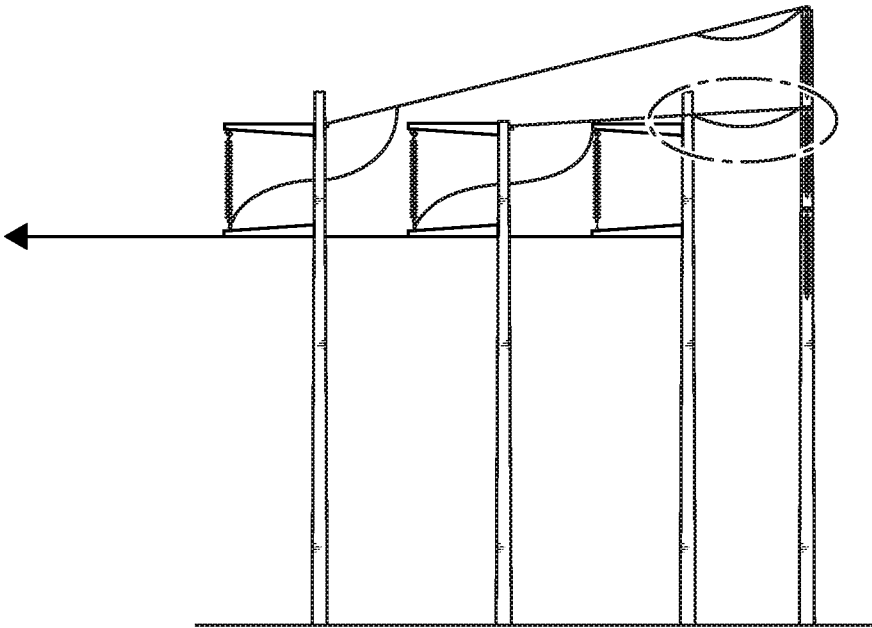


Fig. 25a

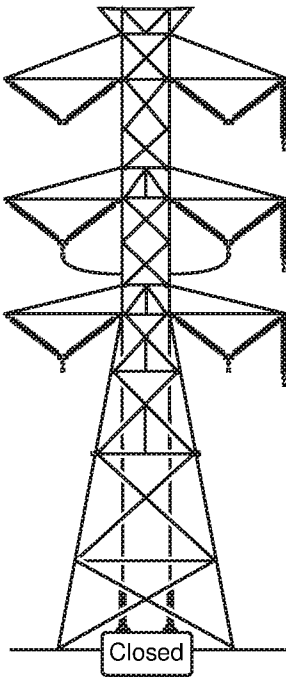


Fig. 25b

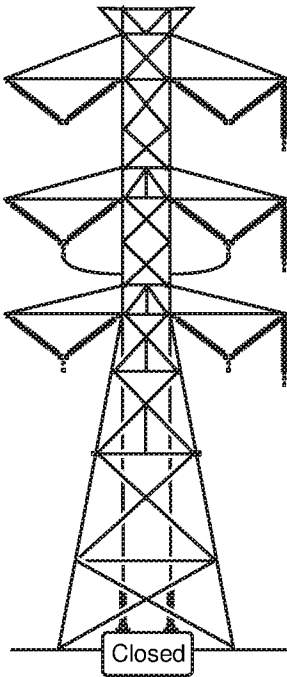


Fig. 25c

51/100

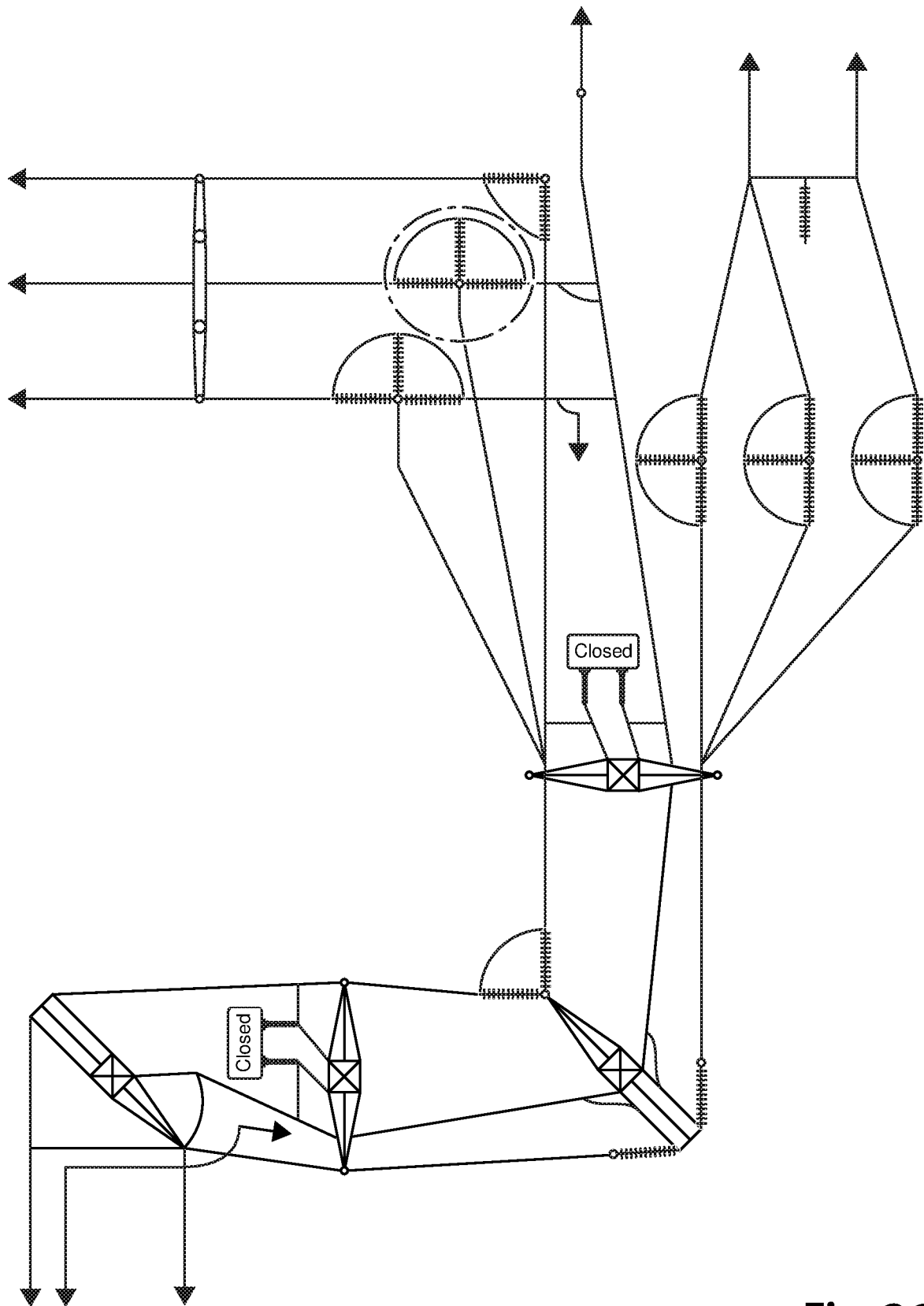


Fig. 26

52/100

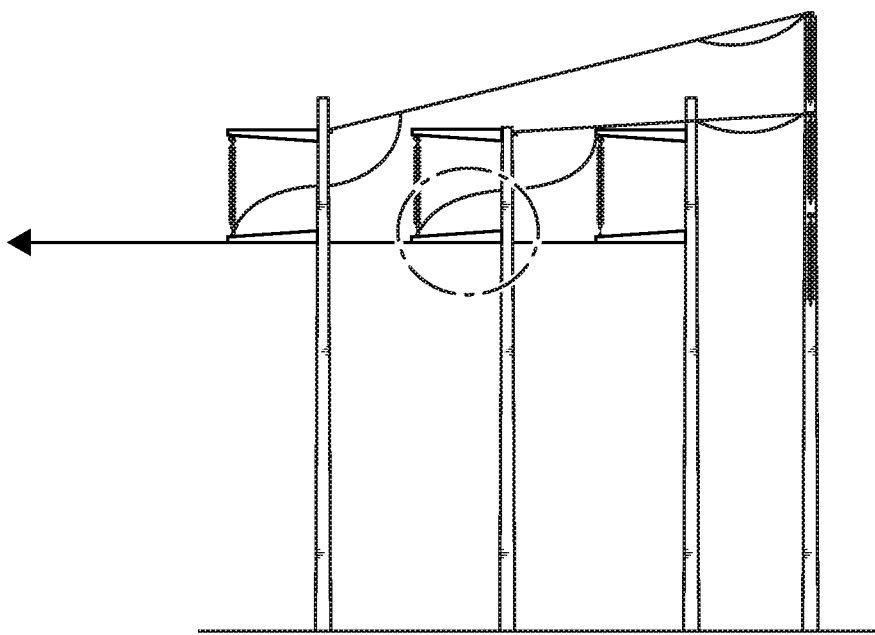


Fig. 26a

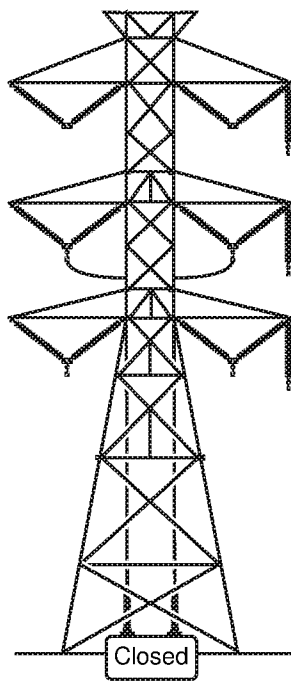


Fig. 26b

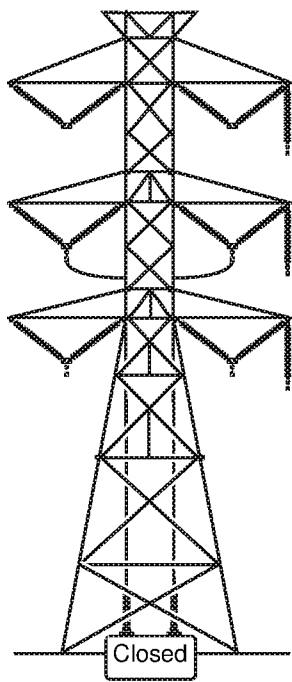


Fig. 26c

53/100

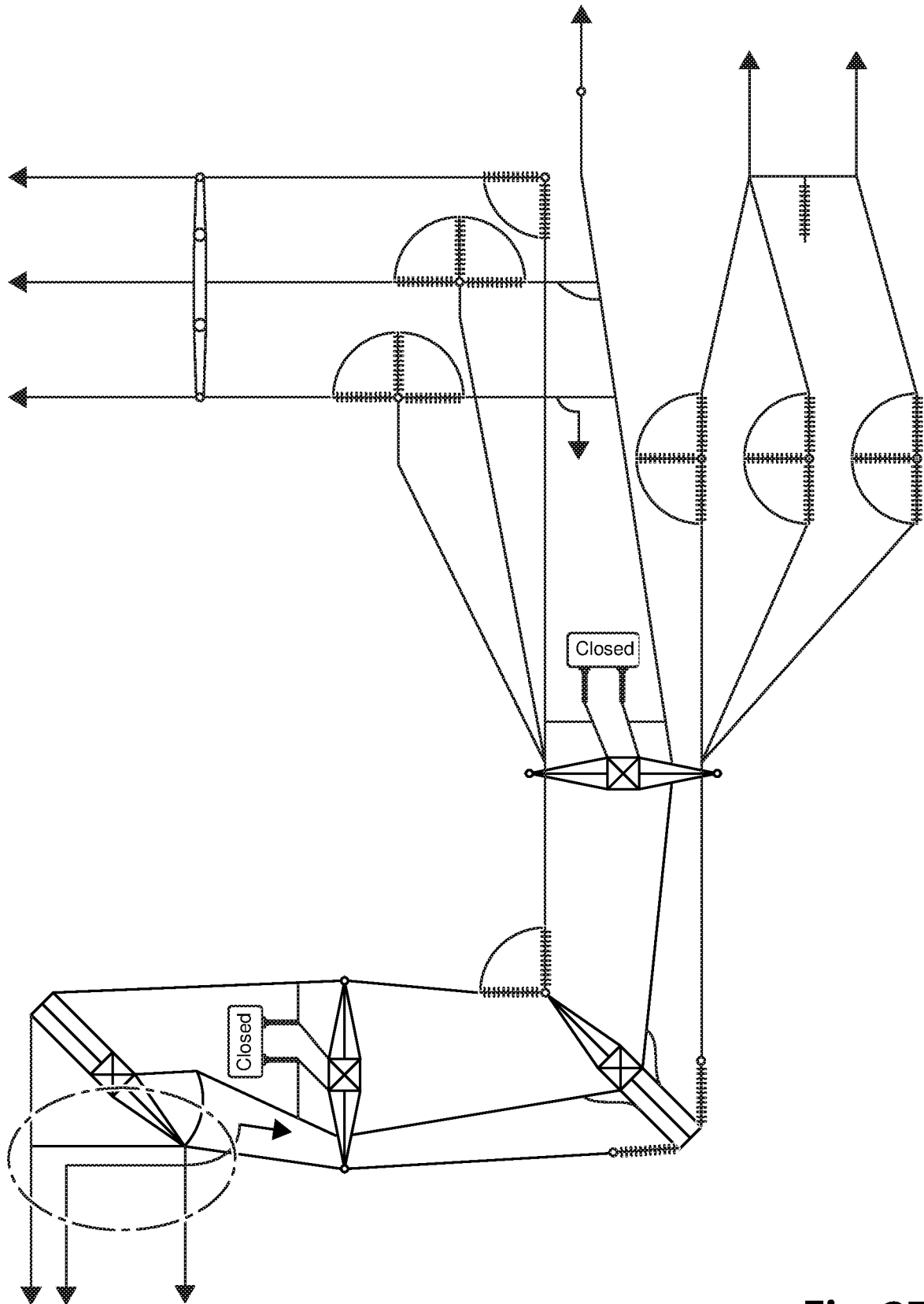


Fig. 27

54/100

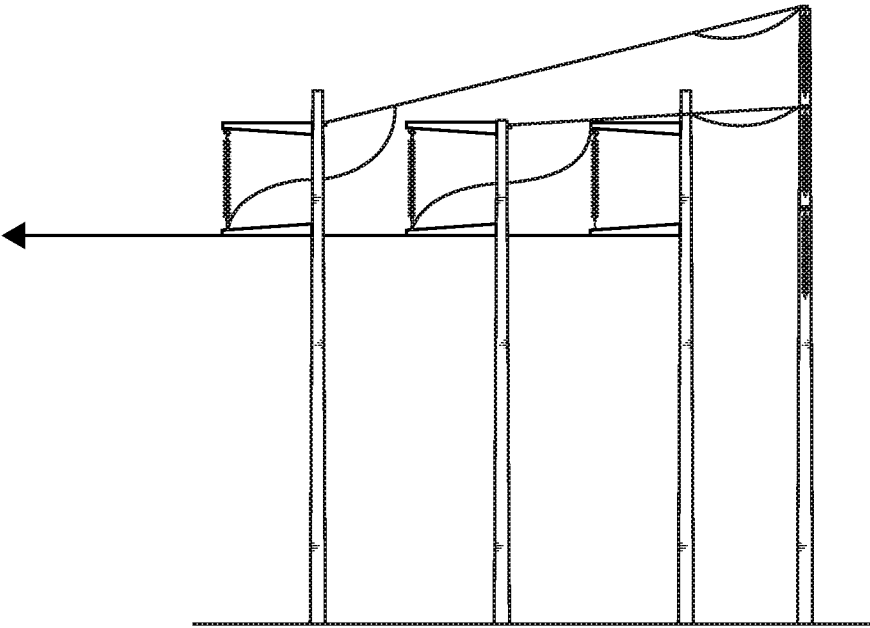


Fig. 27a

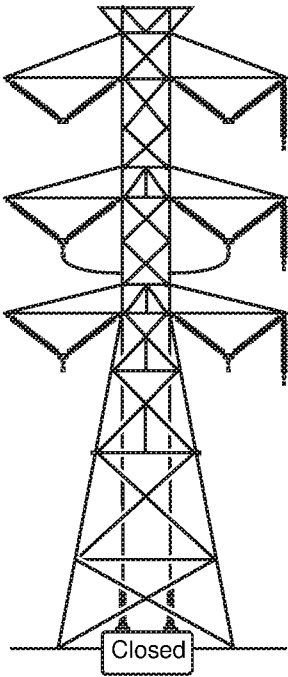


Fig. 27b

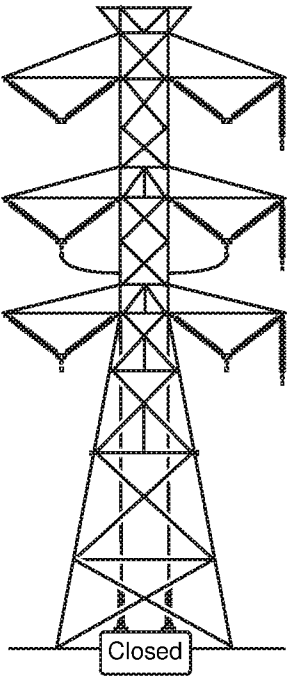


Fig. 27c

55/100

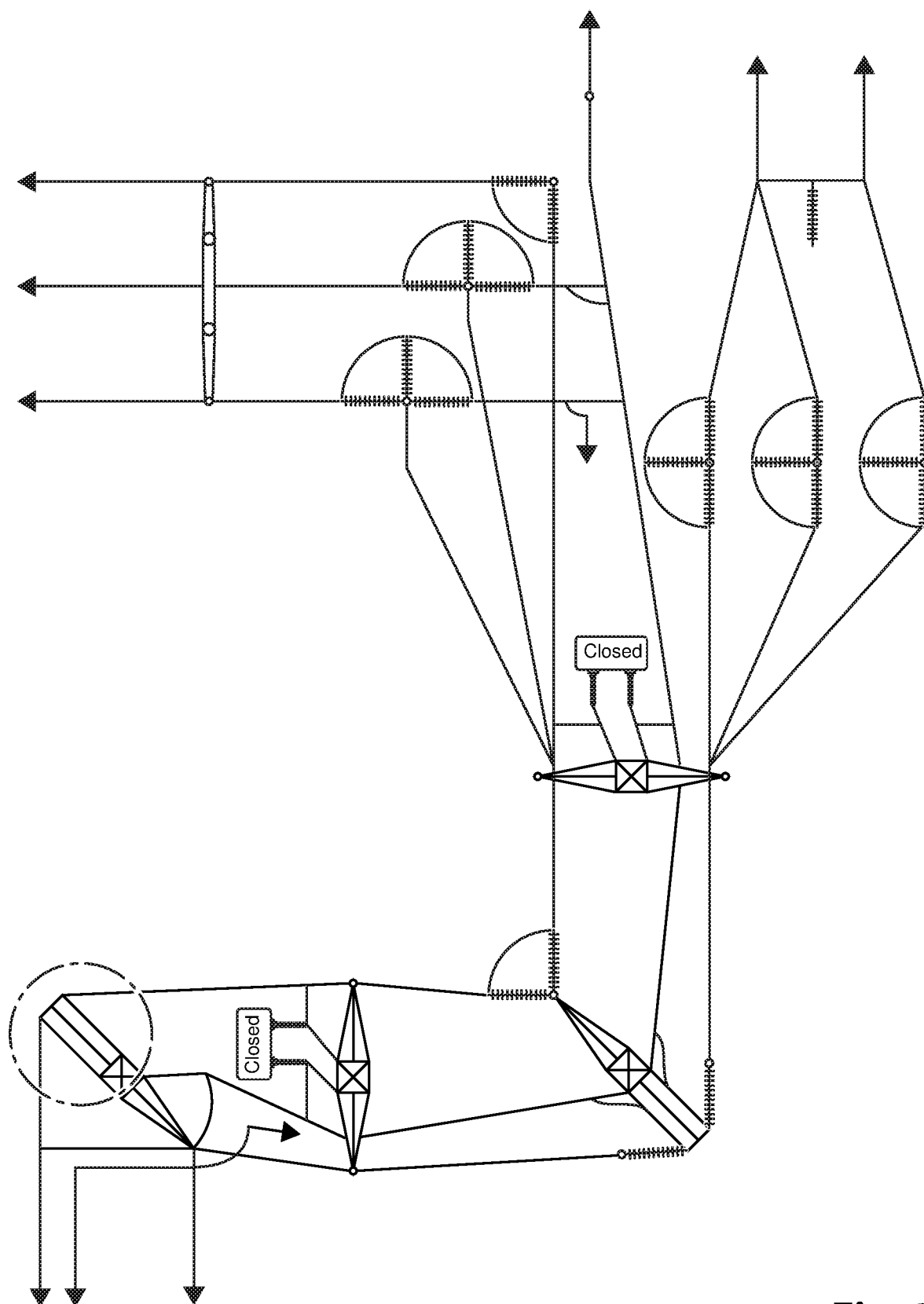


Fig. 28

56/100

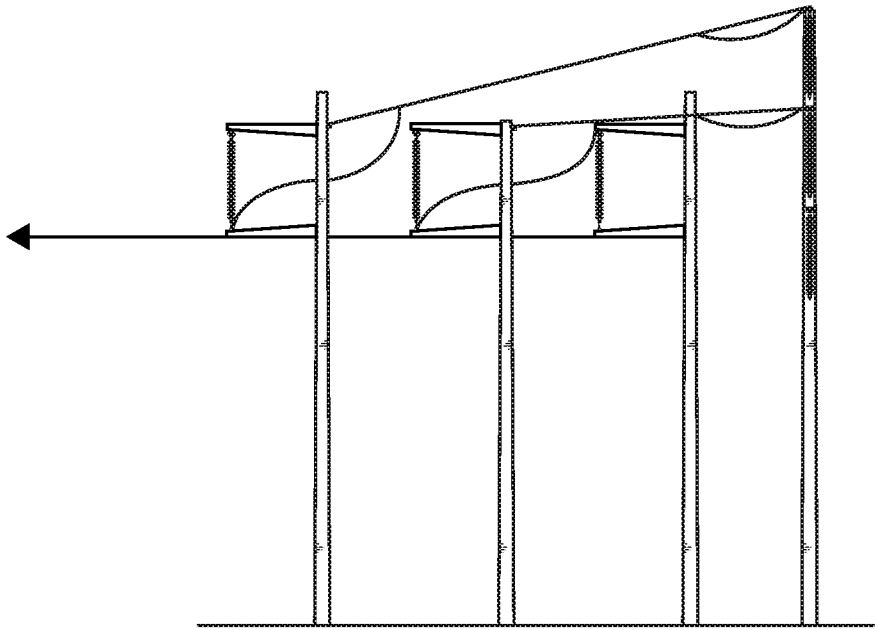


Fig. 28a

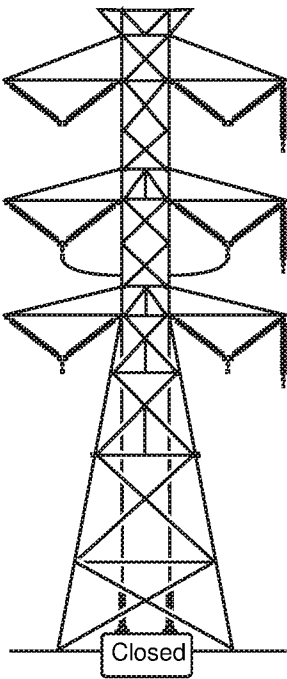


Fig. 28b

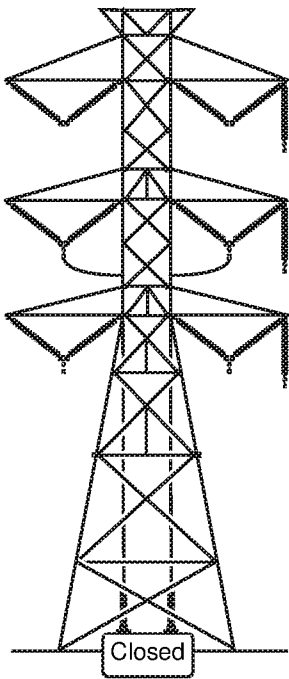


Fig. 28c

57/100

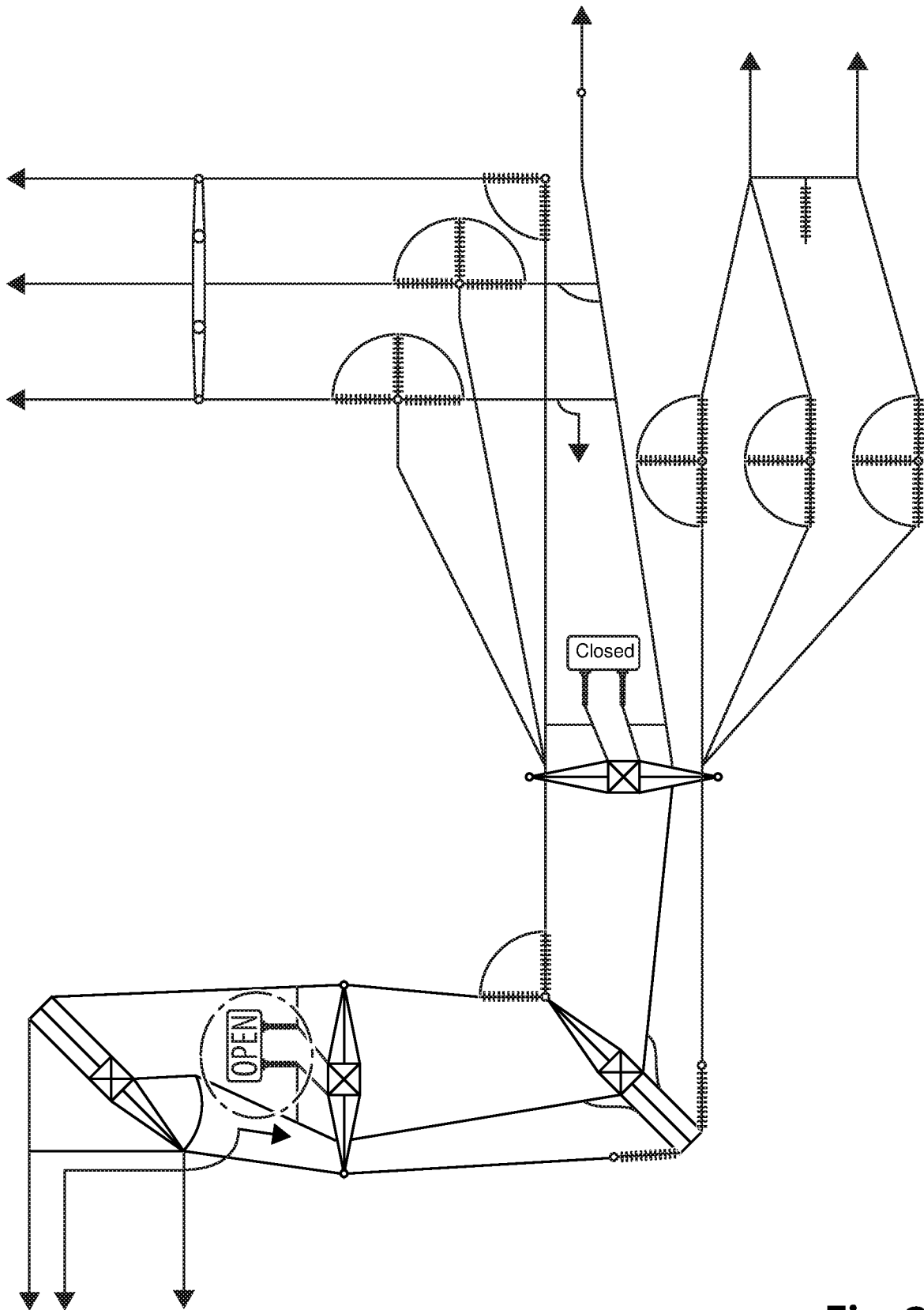


Fig. 29

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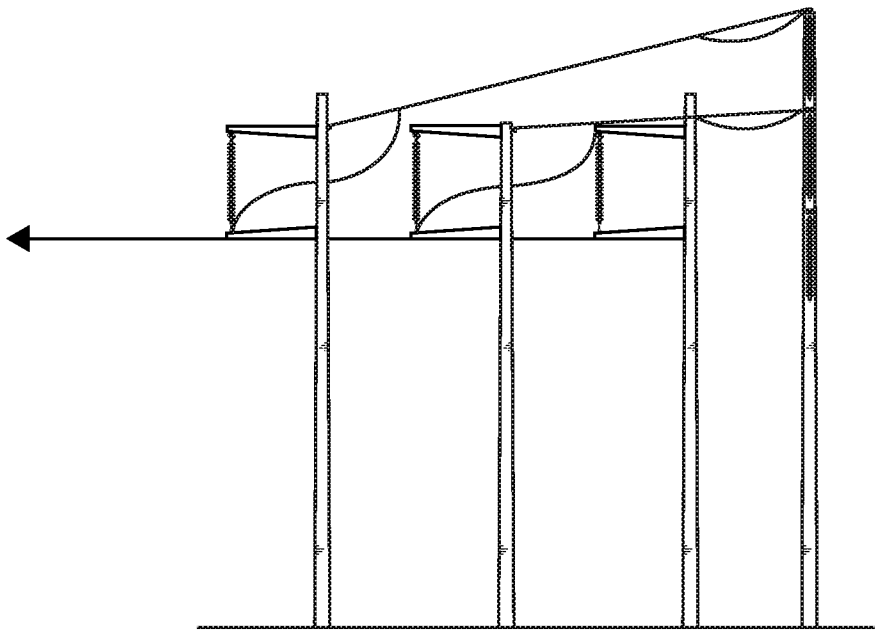


Fig. 29a

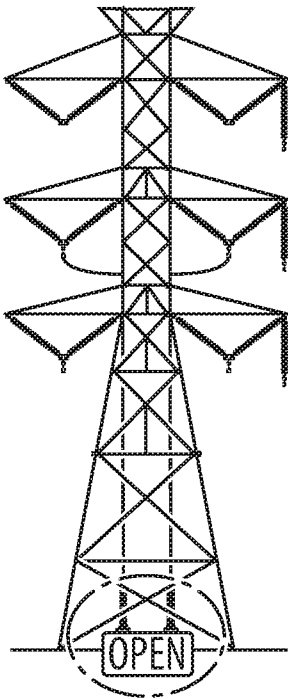


Fig. 29b

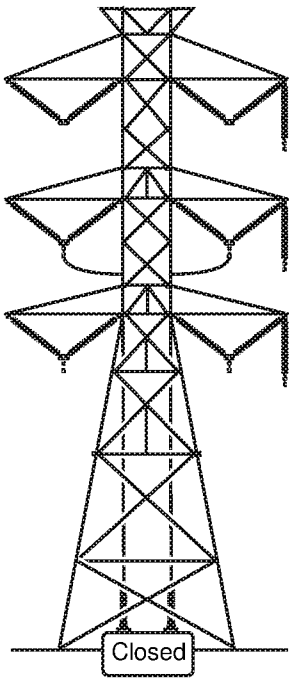


Fig. 29c

59/100

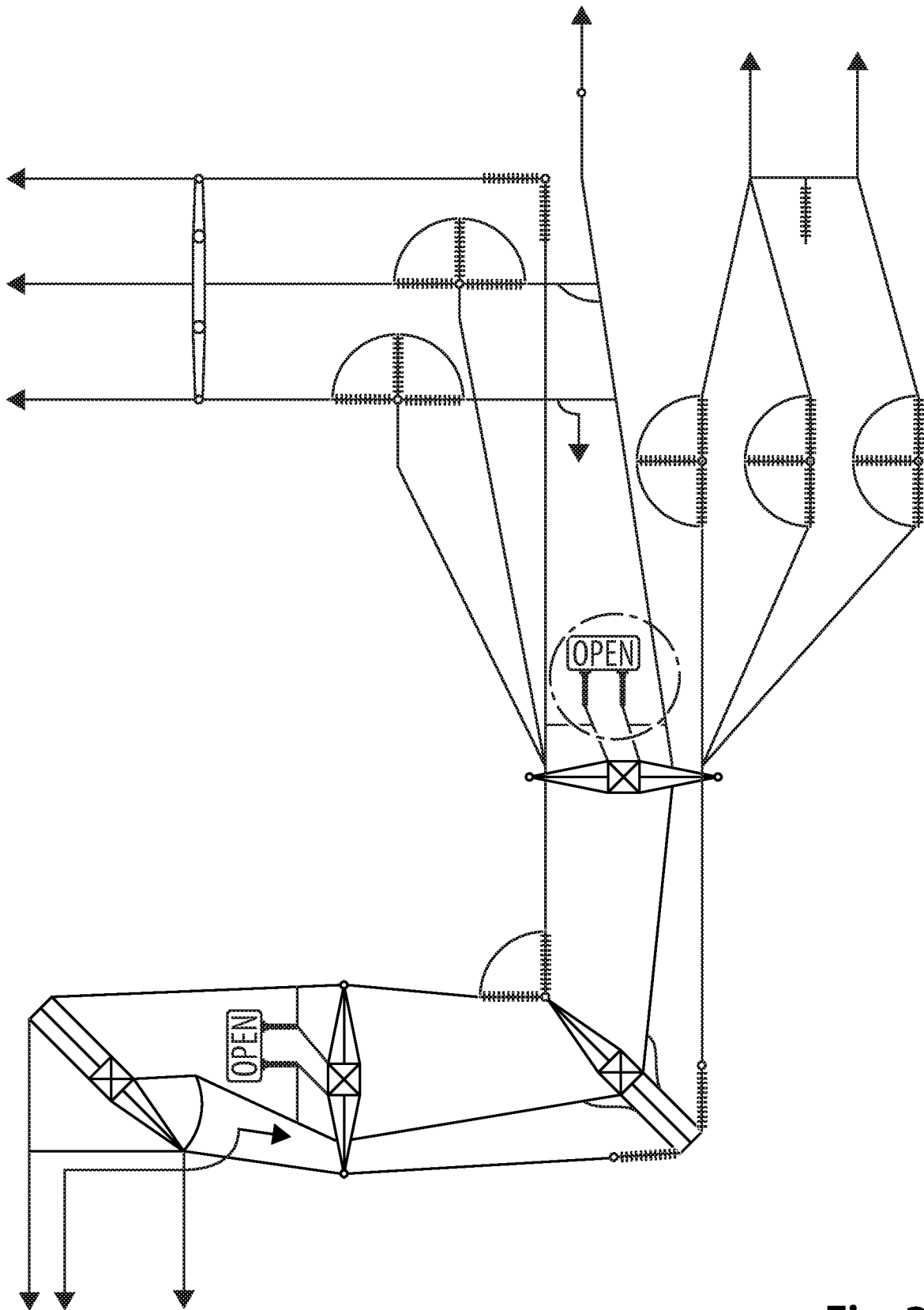


Fig. 30

60/100

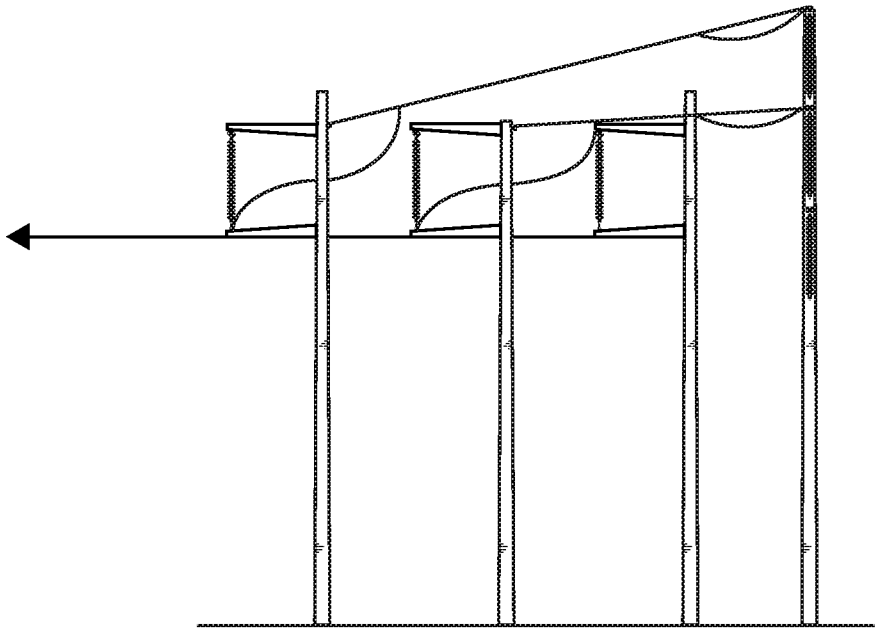


Fig. 30a

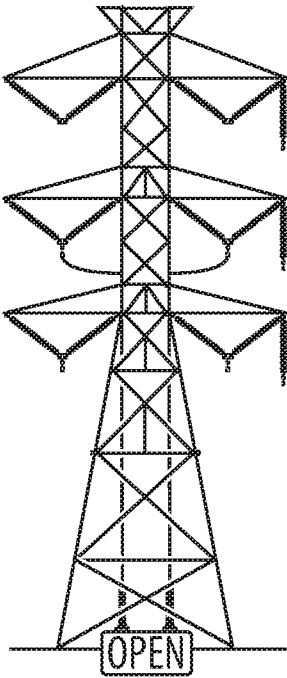


Fig. 30b

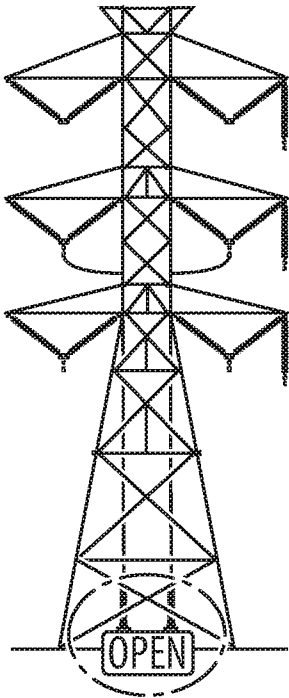


Fig. 30c

61/100

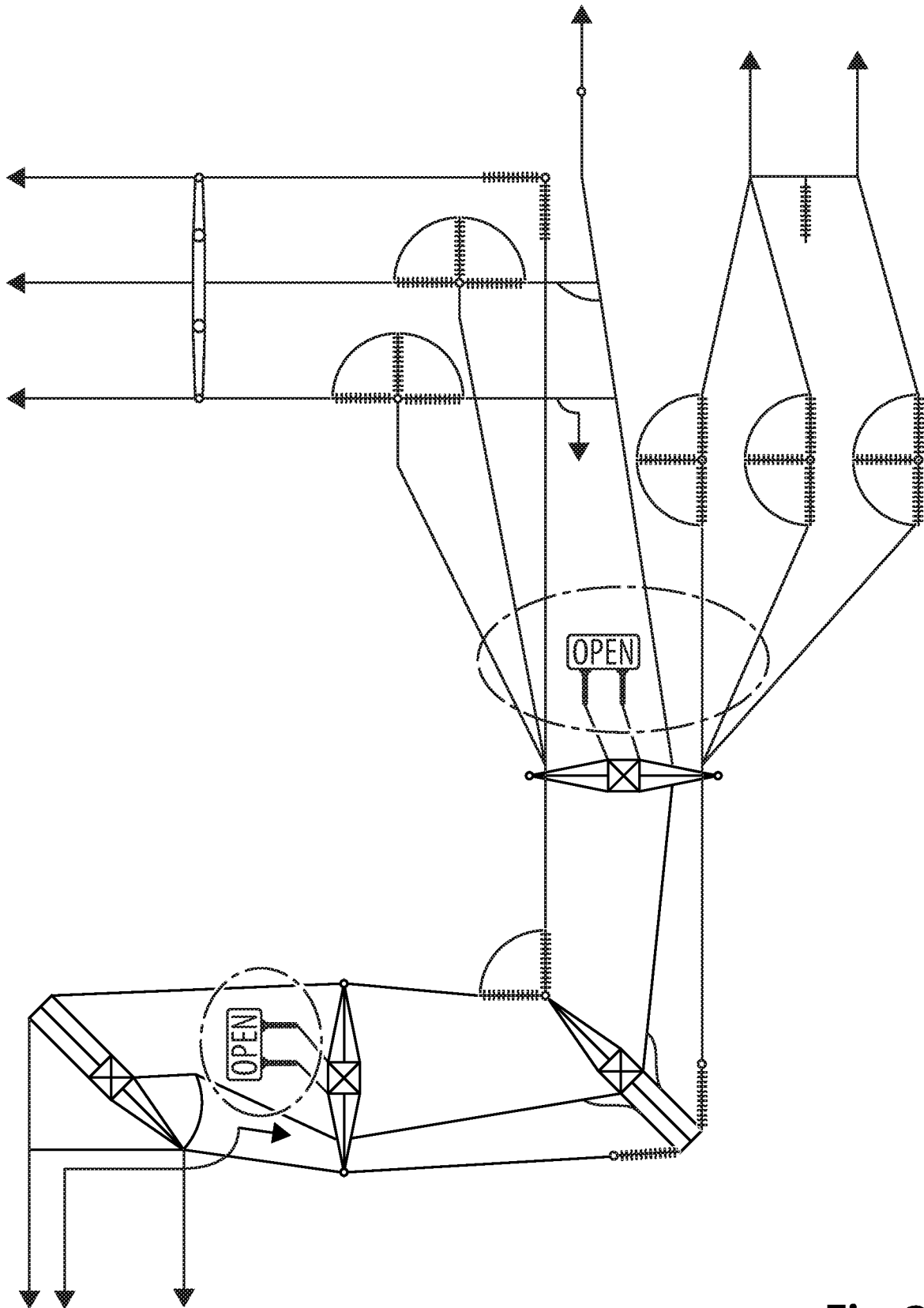


Fig. 31

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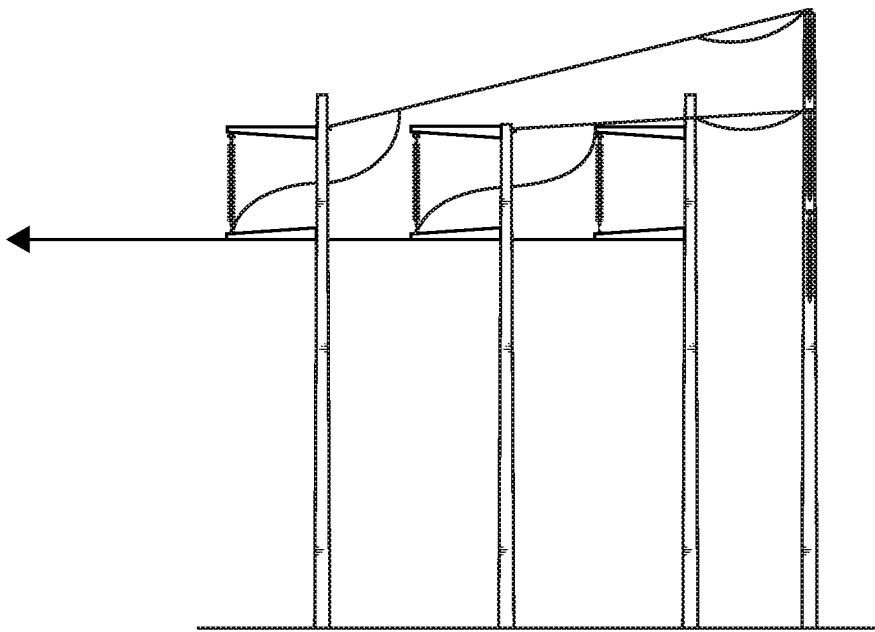


Fig. 31a

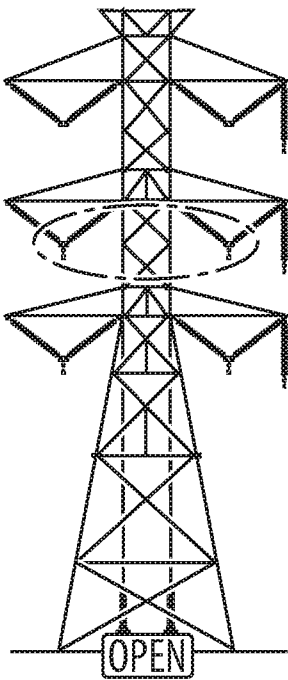


Fig. 31b

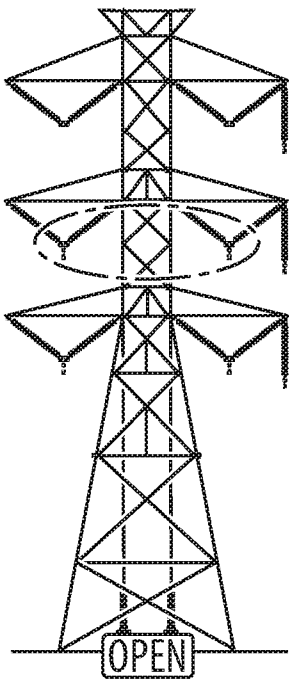


Fig. 31c

63/100

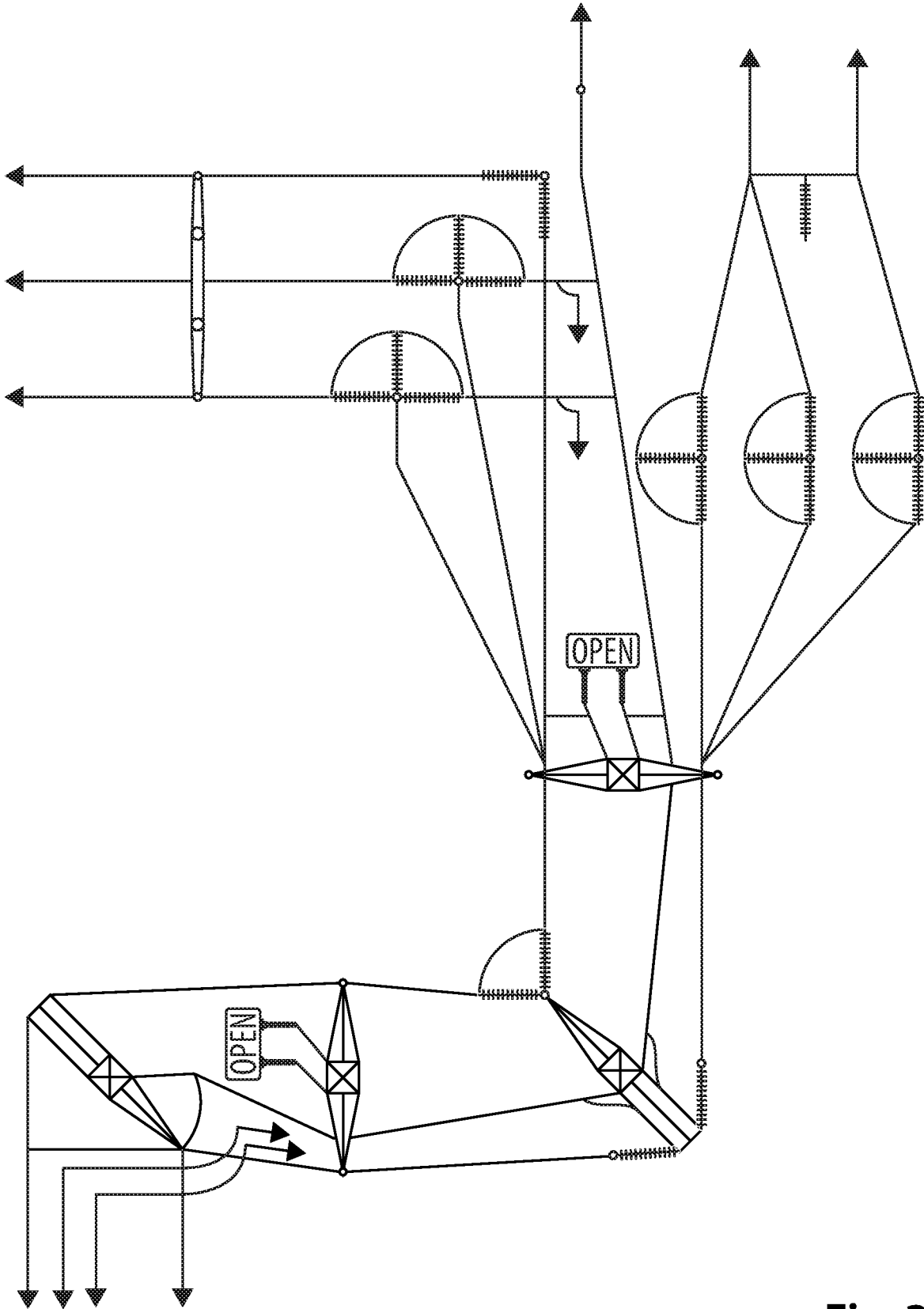


Fig. 32

64/100

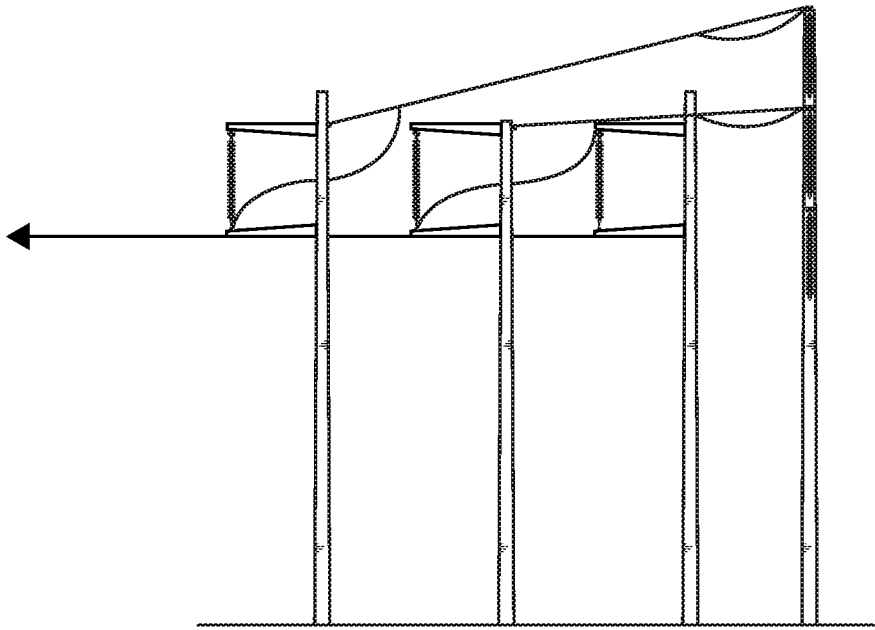


Fig. 32a

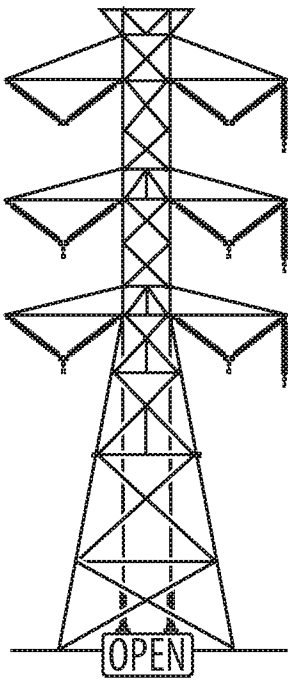


Fig. 32b

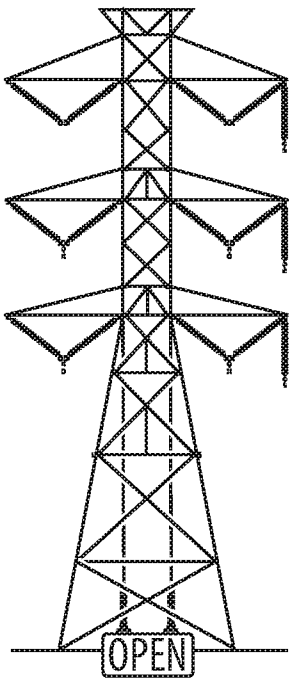


Fig. 32c

65/100

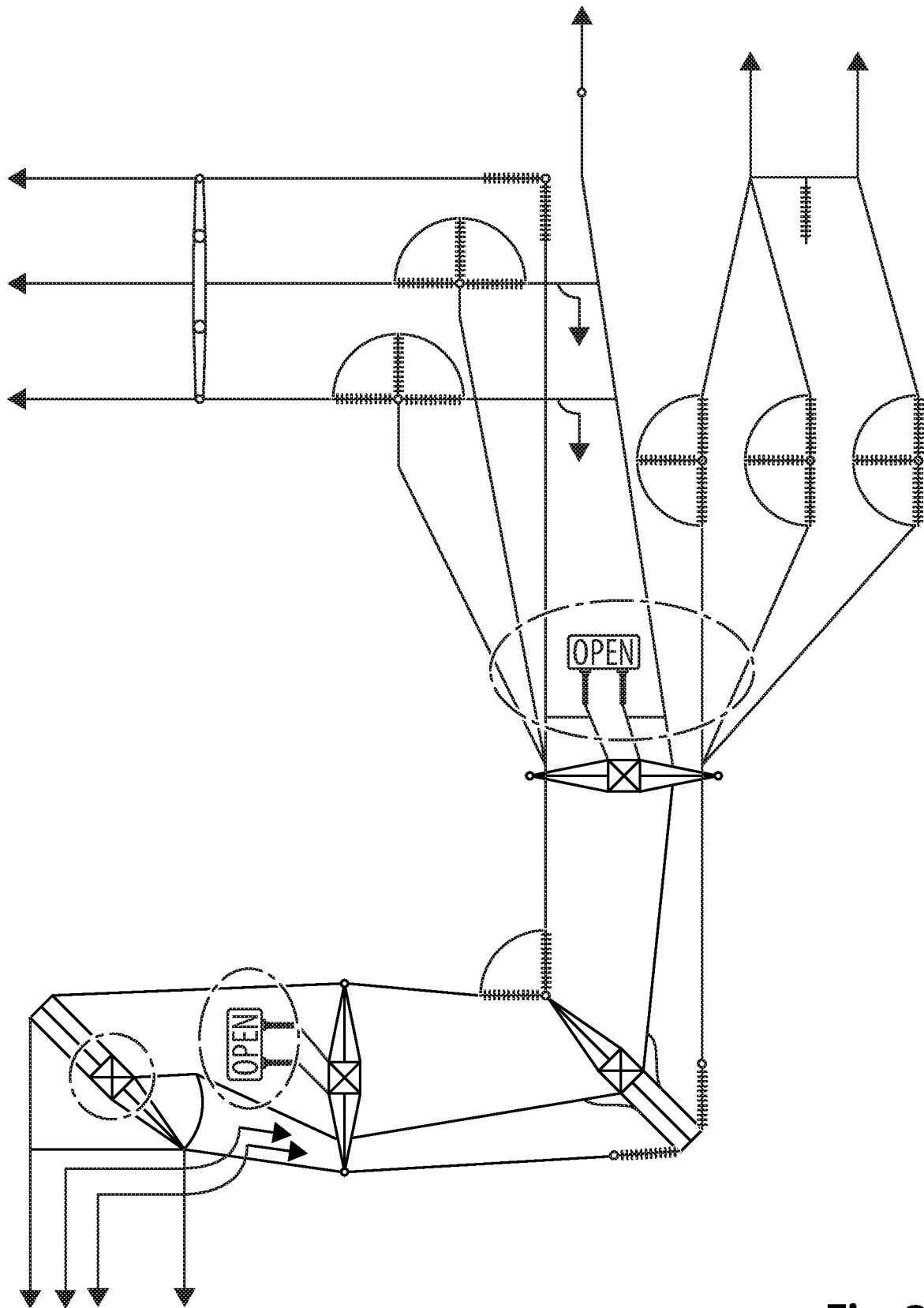


Fig. 33

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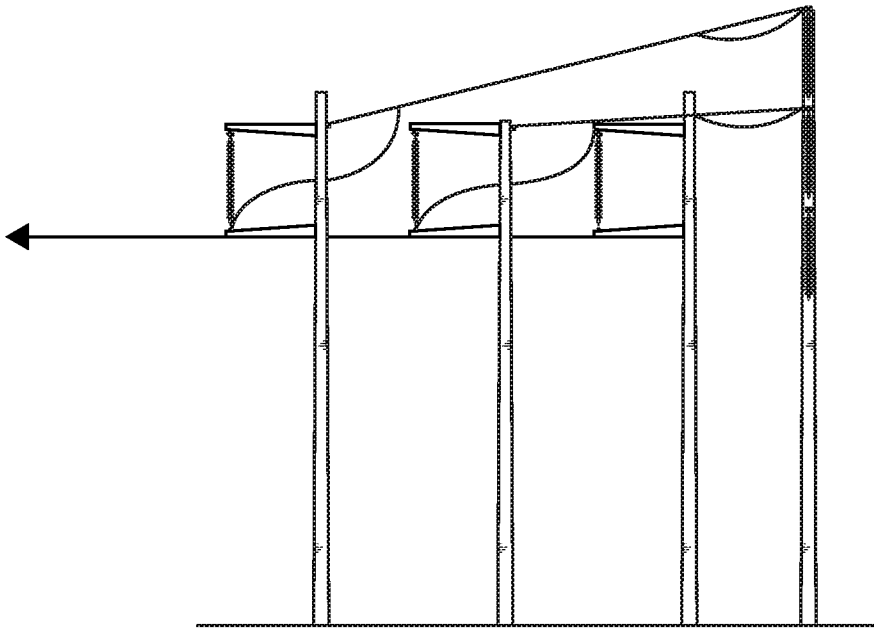


Fig. 33a

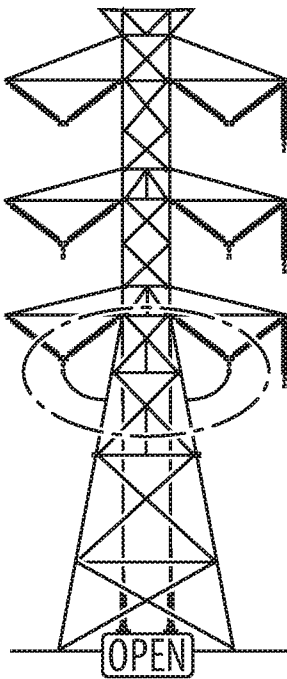


Fig. 33b

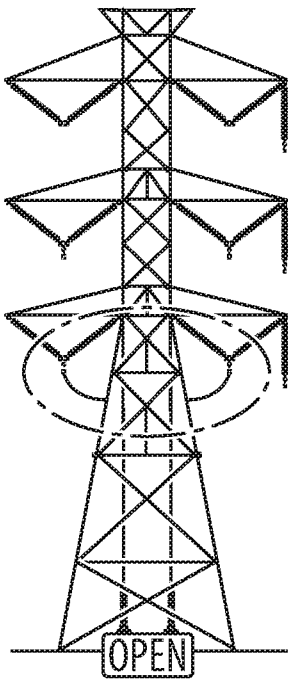


Fig. 33c

67/100

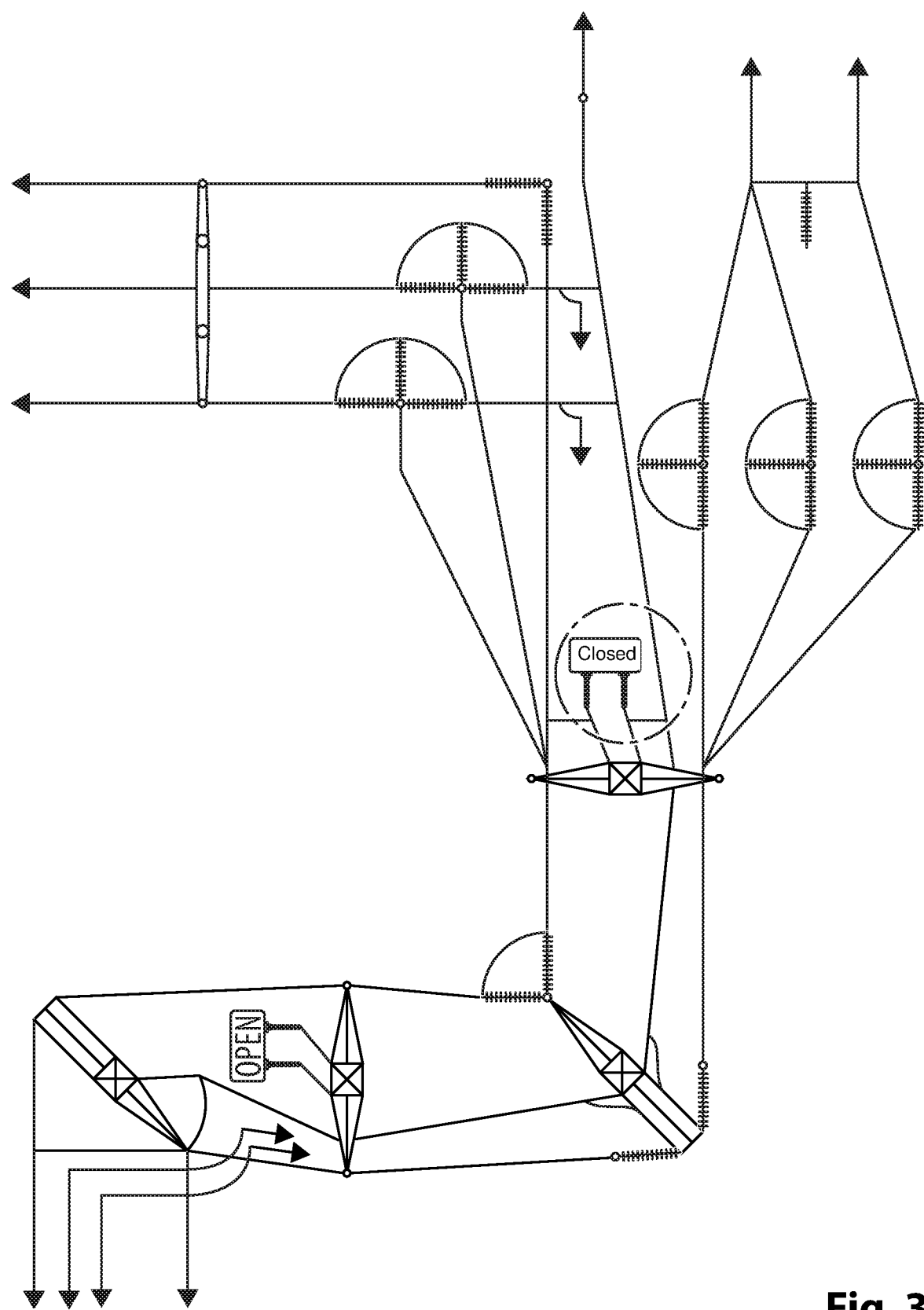


Fig. 34

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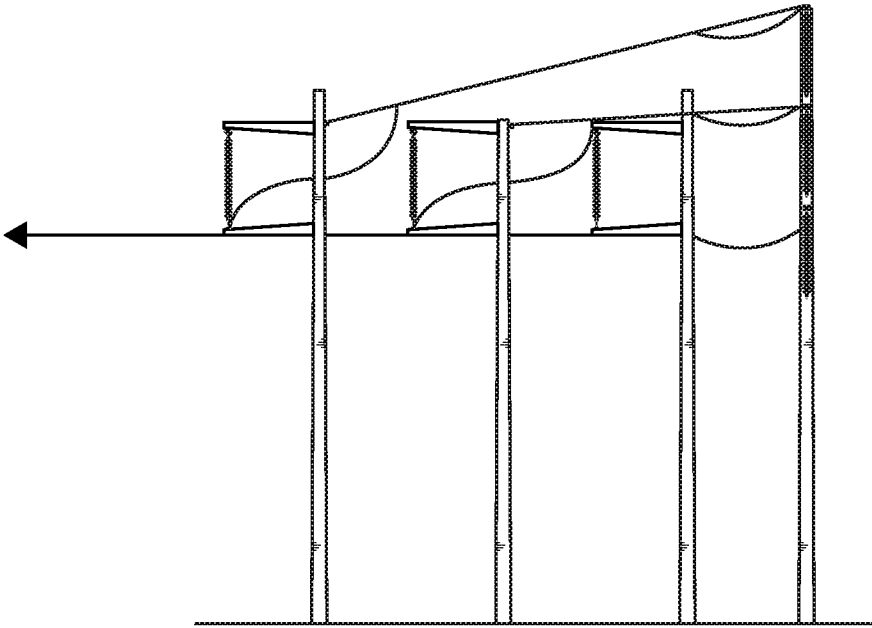


Fig. 34a

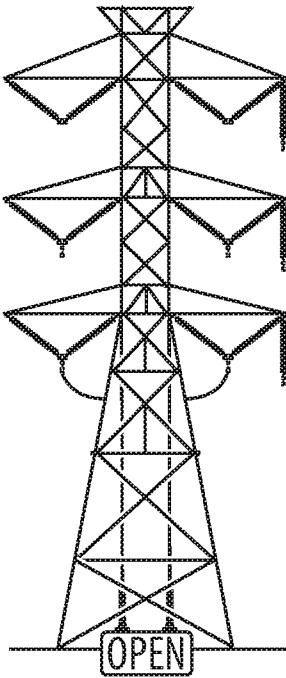


Fig. 34b

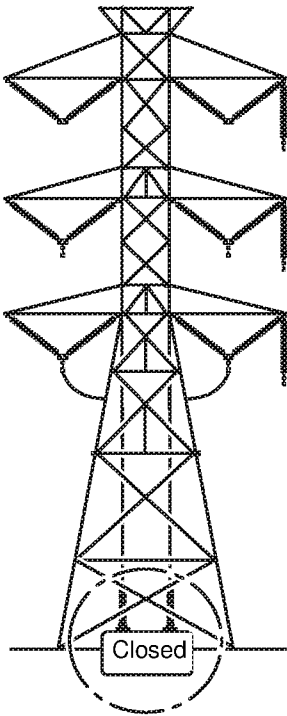


Fig. 34c

69/100

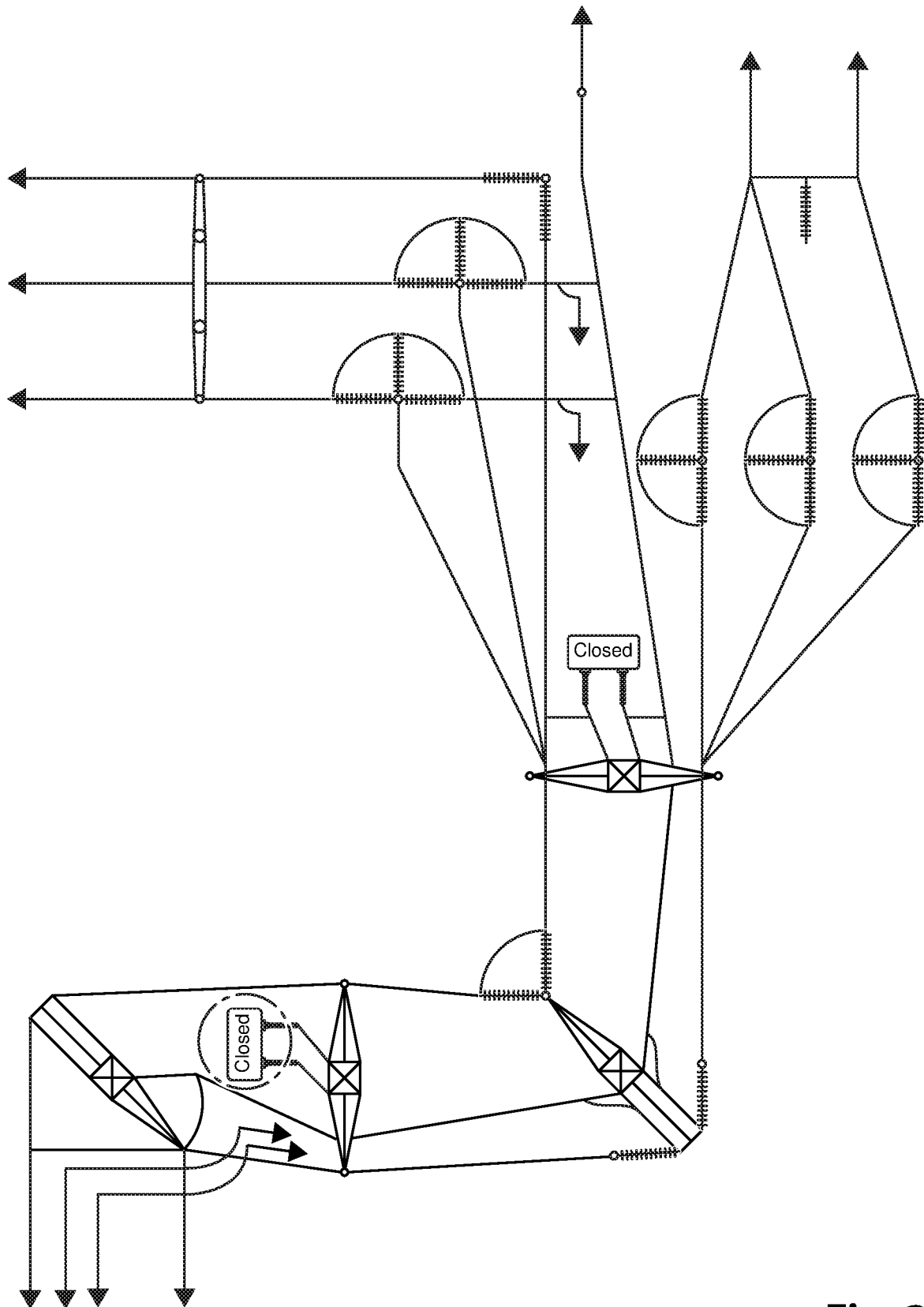


Fig. 35

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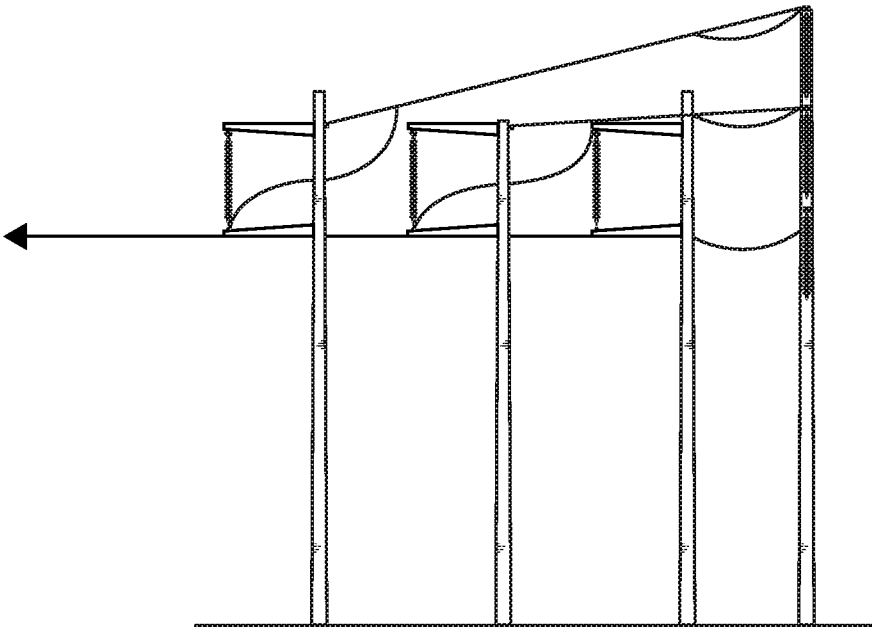


Fig. 35a

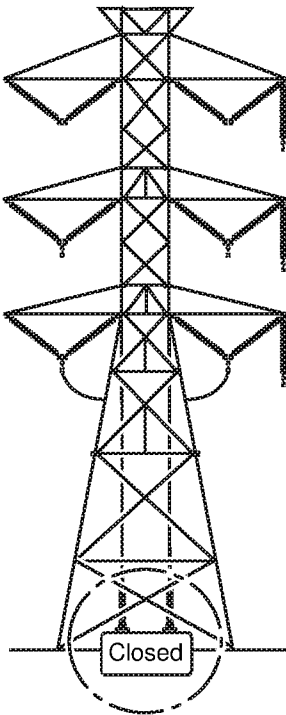


Fig. 35b

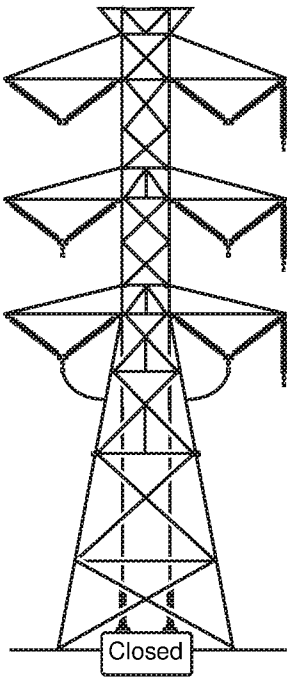


Fig. 35c

71/100

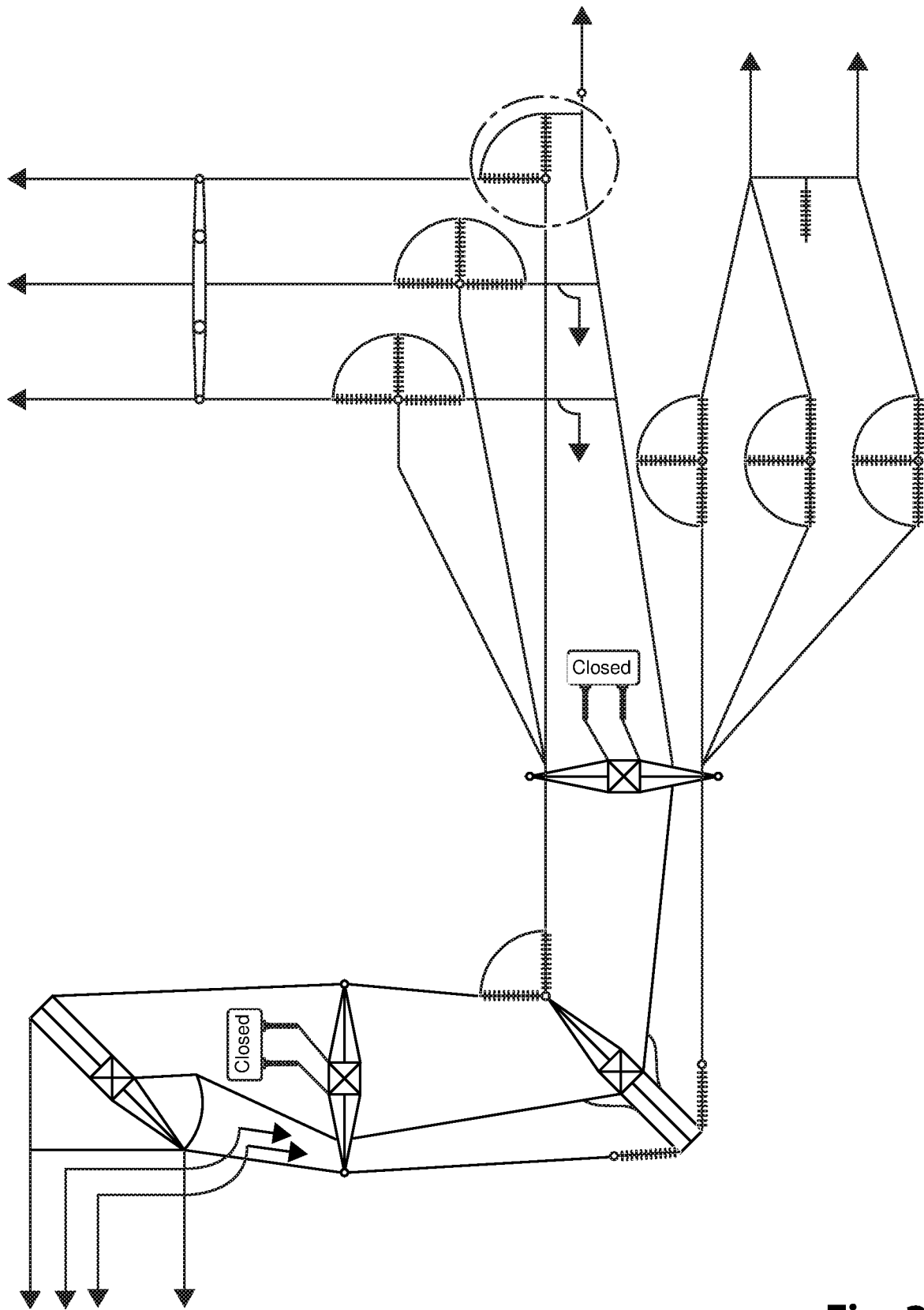


Fig. 36

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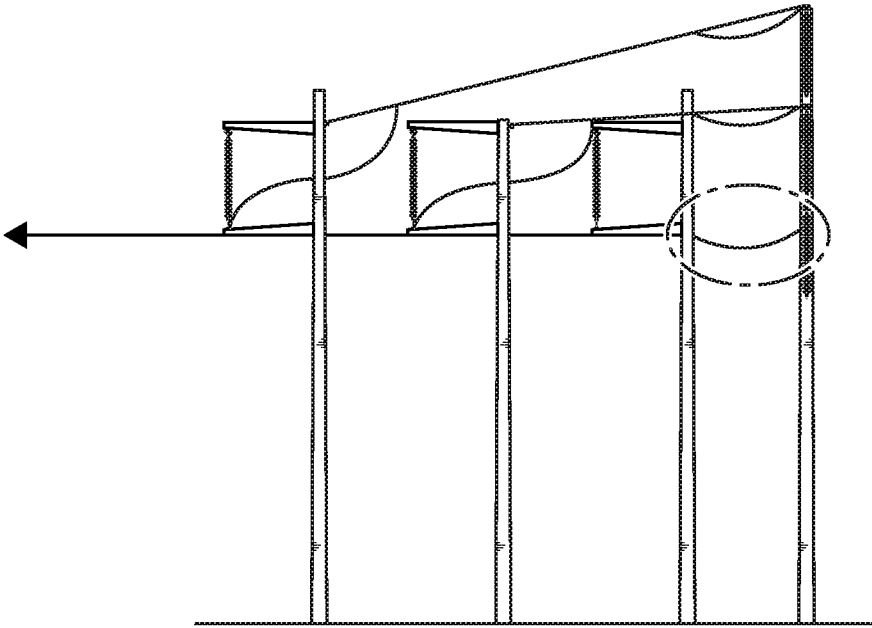


Fig. 36a

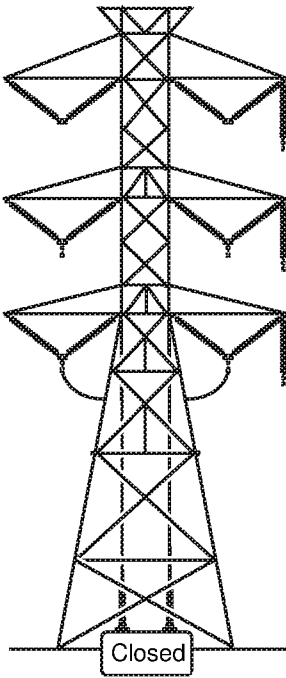


Fig. 36b

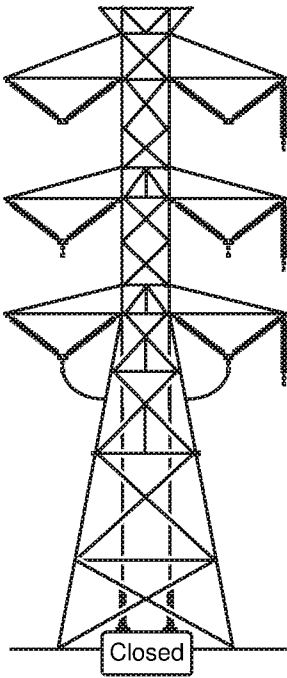


Fig. 36c

73/100

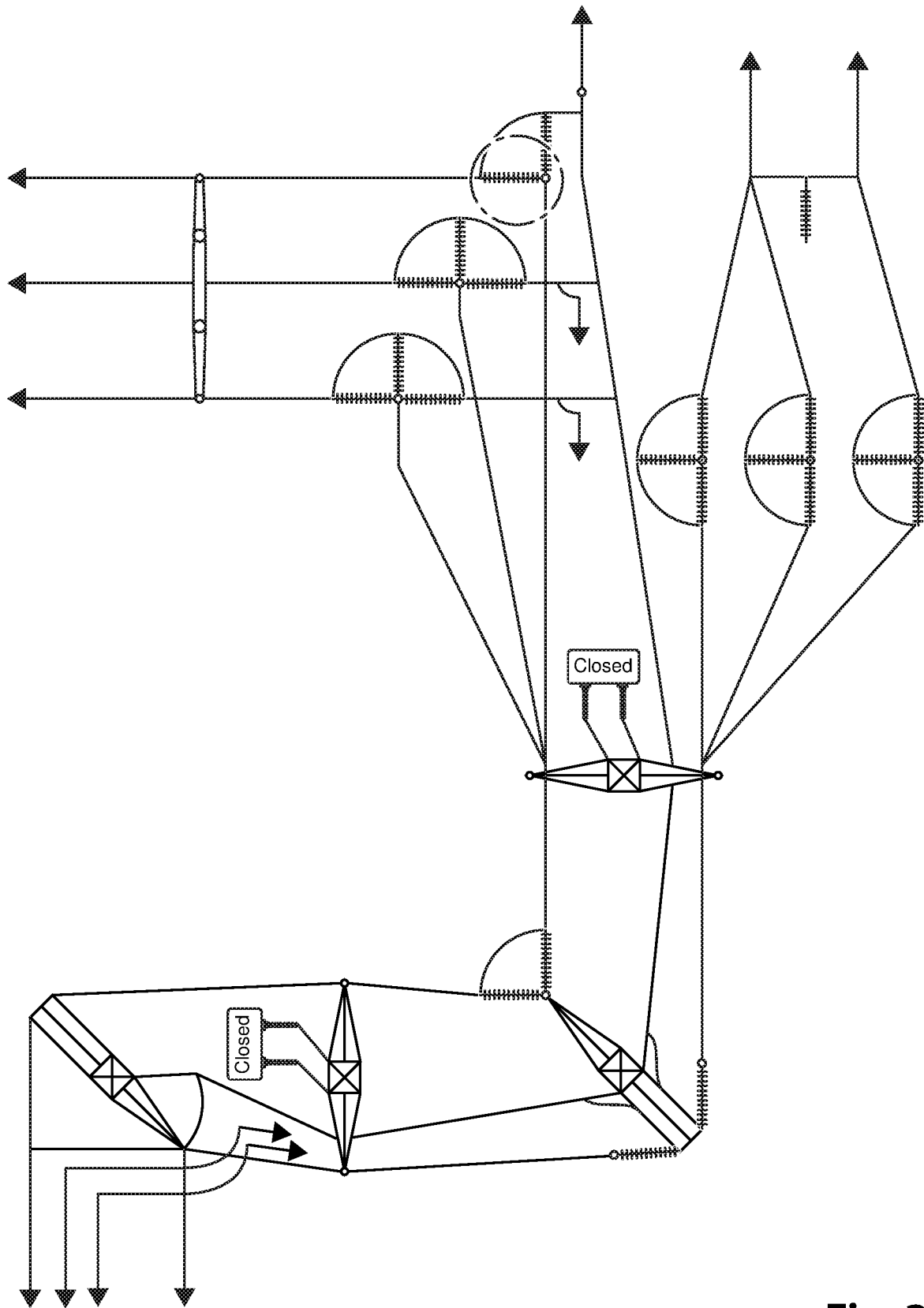


Fig. 37

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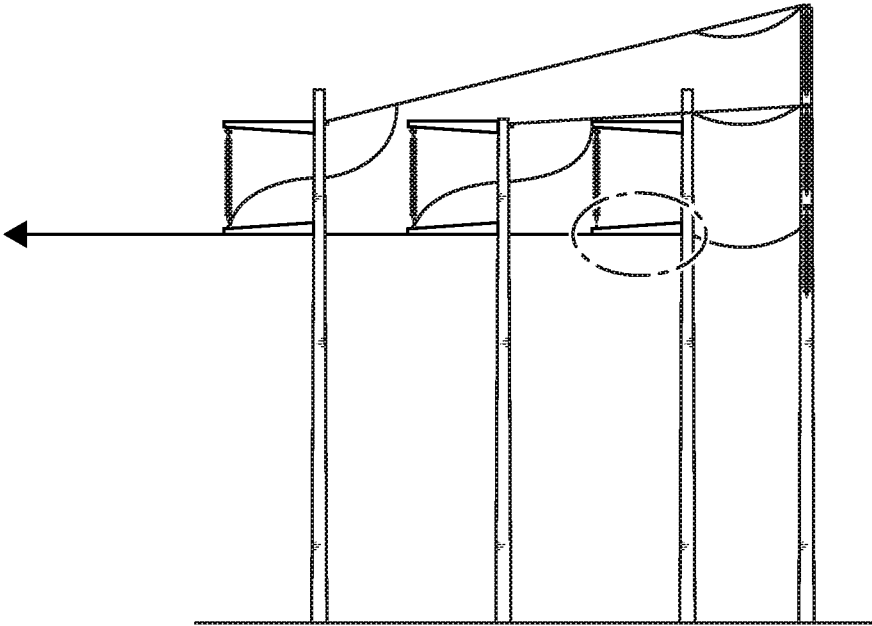


Fig. 37a

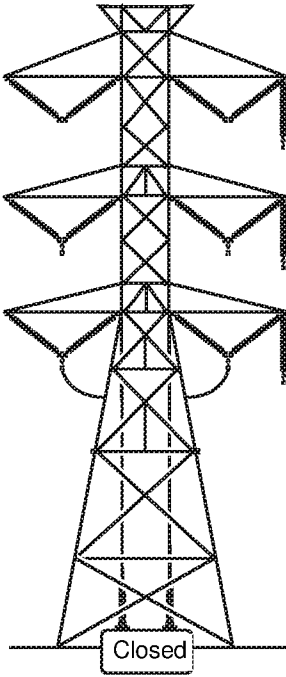


Fig. 37b

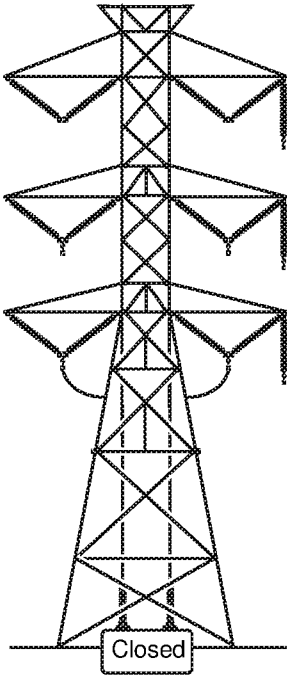


Fig. 37c

75/100

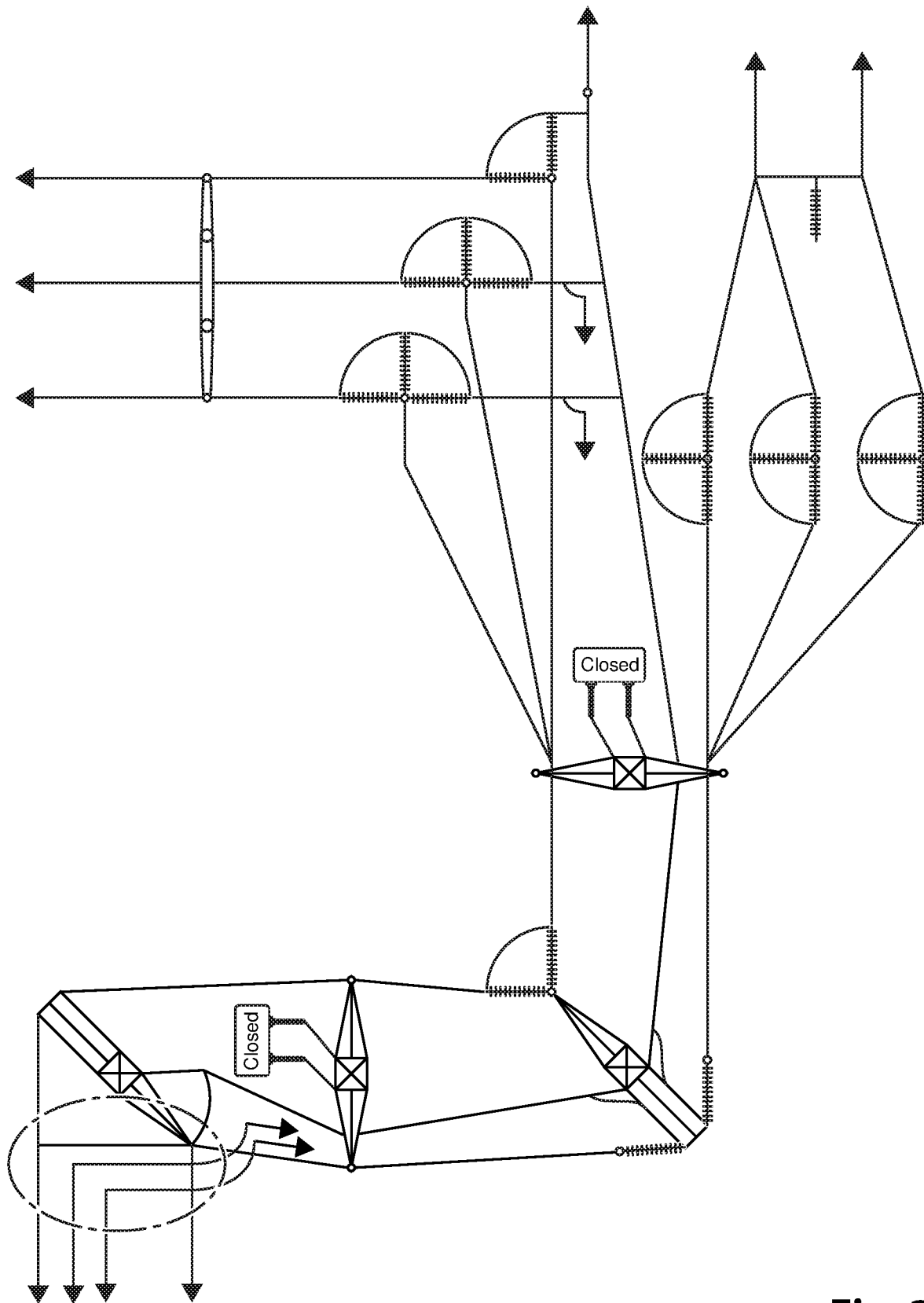


Fig. 38

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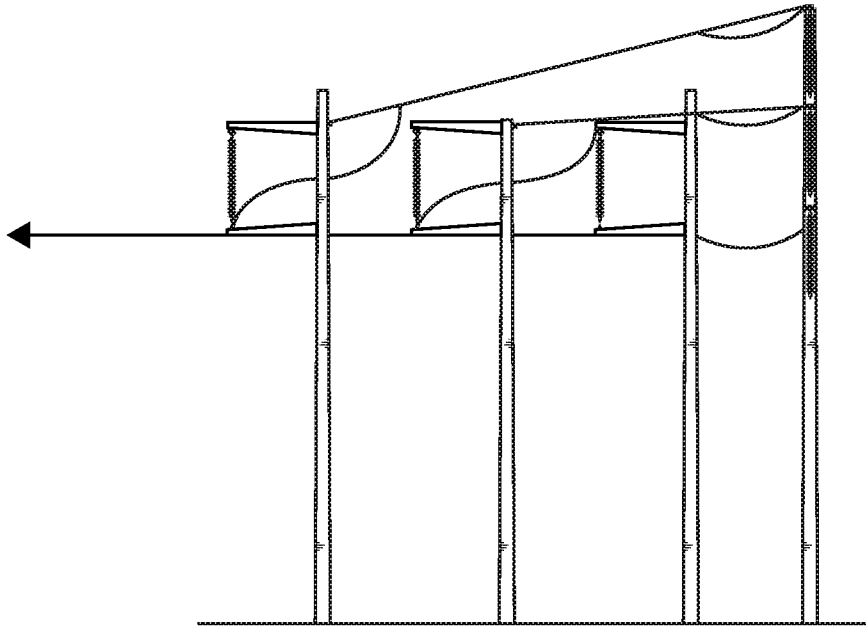


Fig. 38a

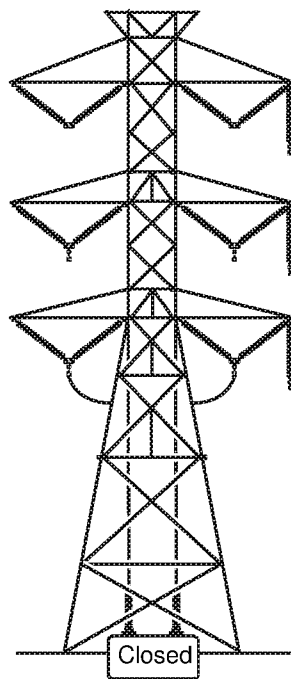


Fig. 38b

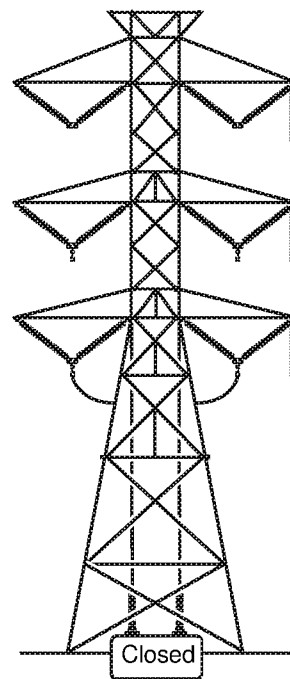


Fig. 38c

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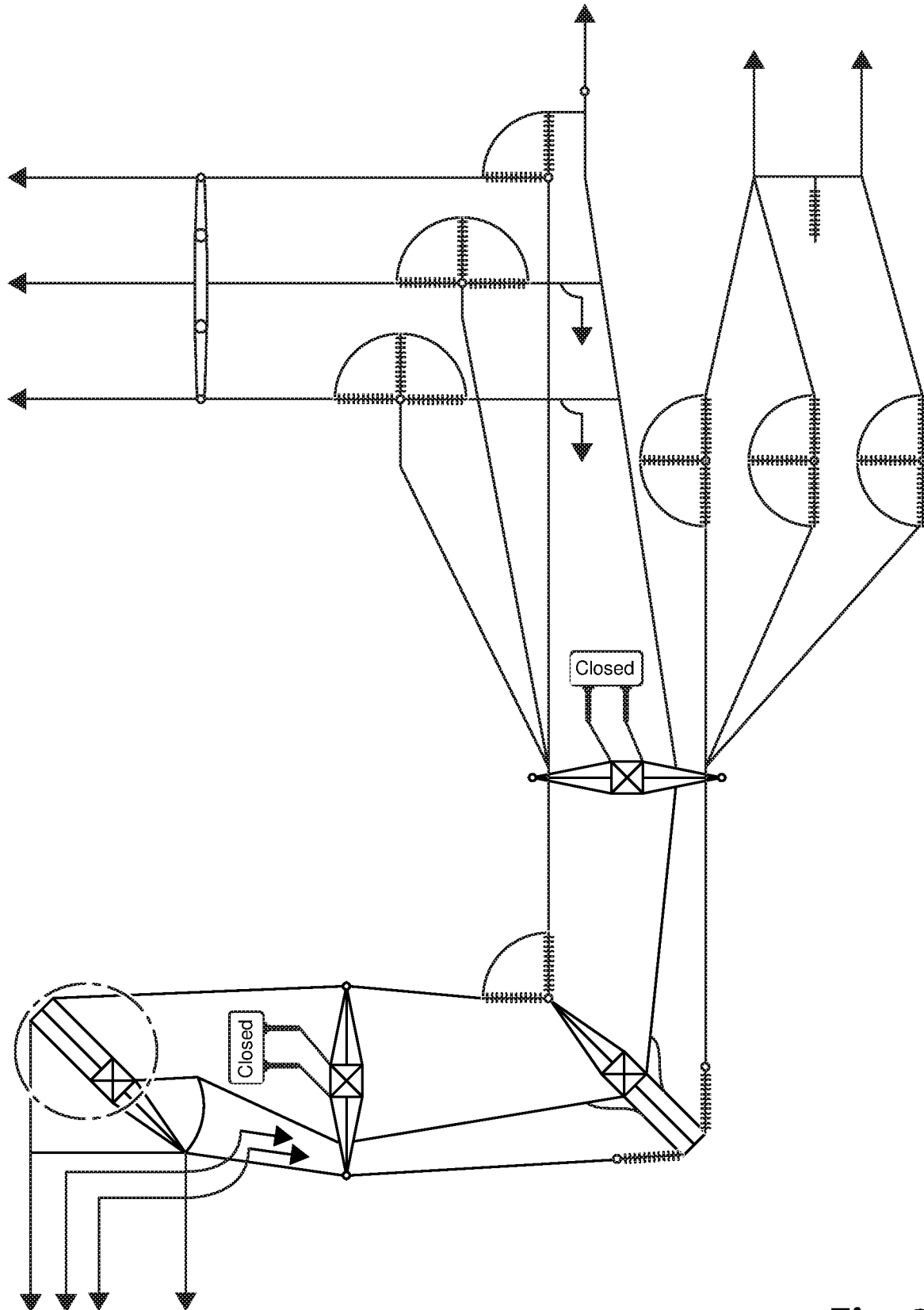


Fig. 39

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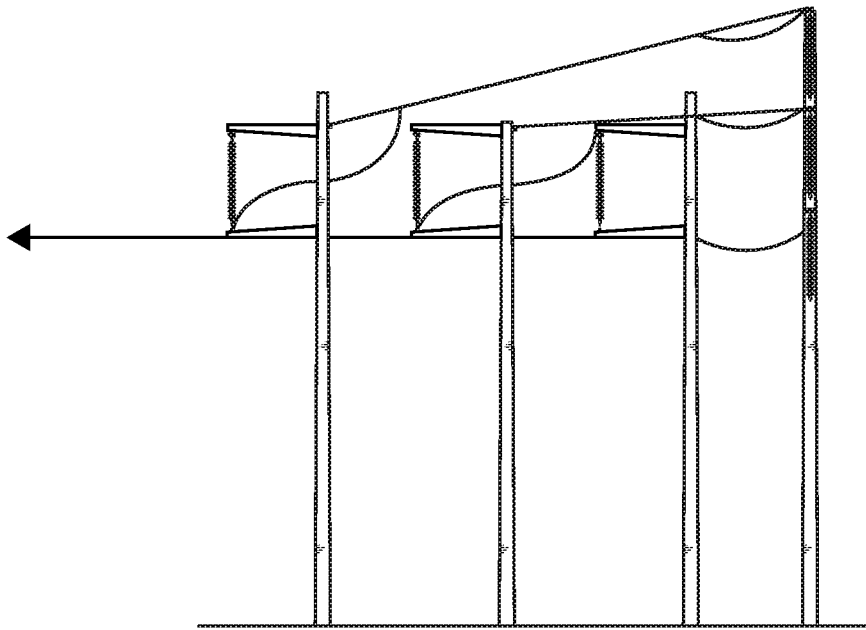


Fig. 39a

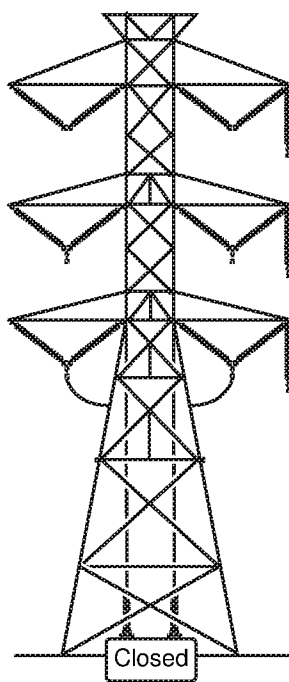


Fig. 39b

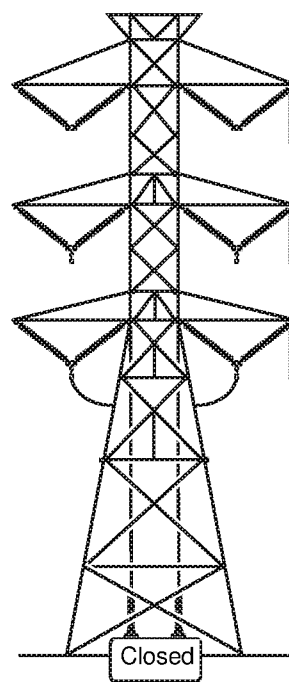


Fig. 39c

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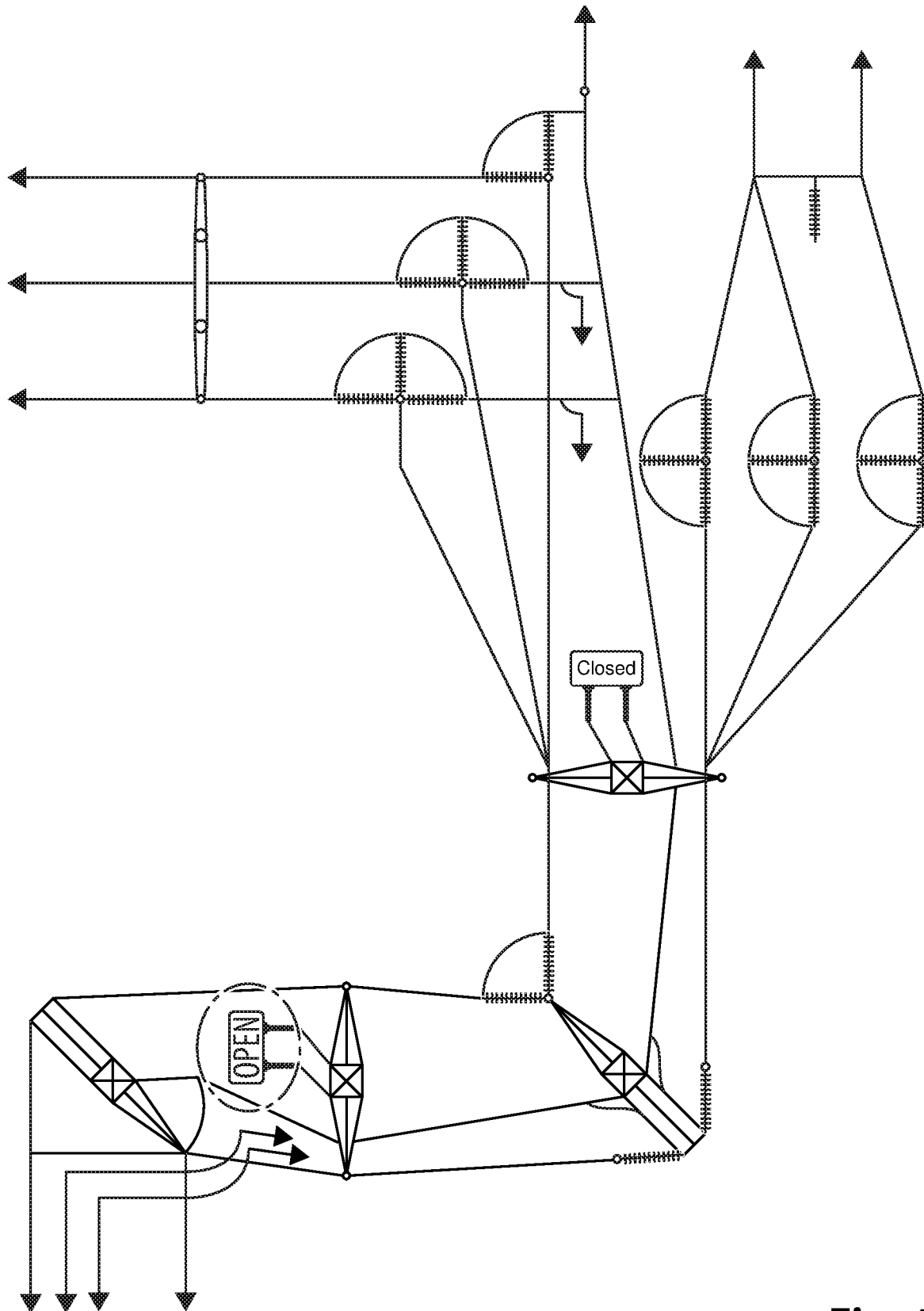


Fig. 40

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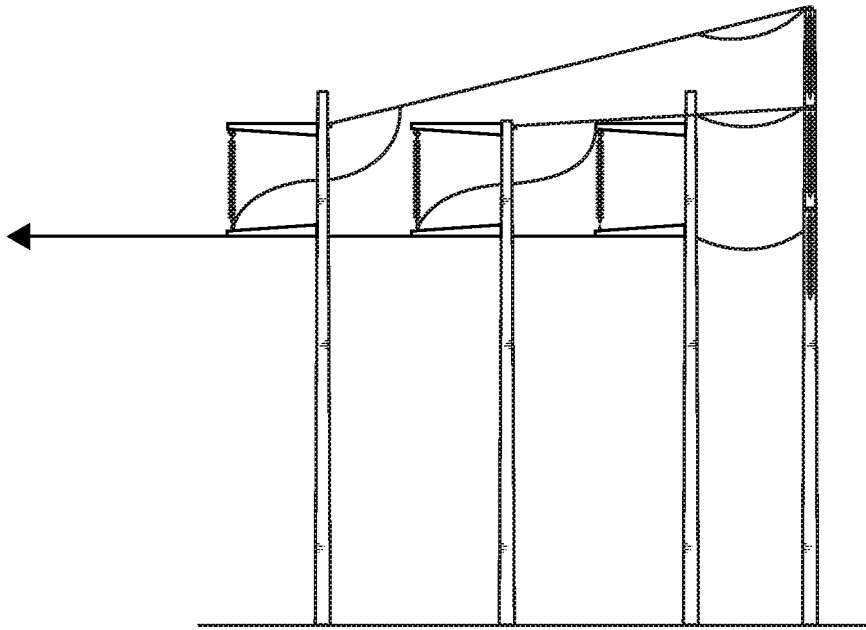


Fig. 40a

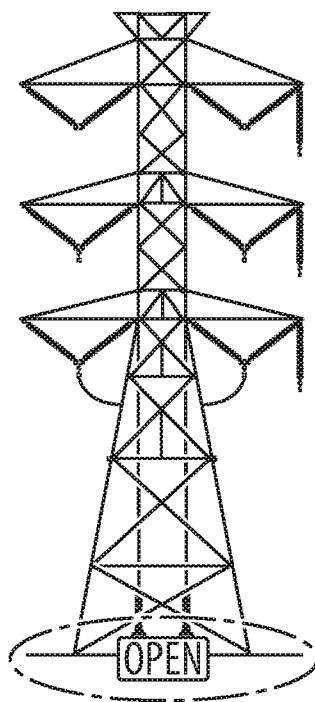


Fig. 40b

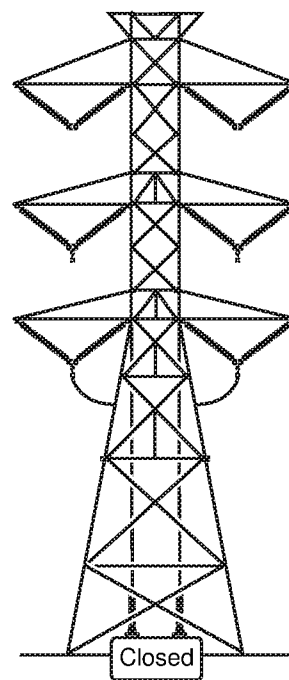


Fig. 40c

81/100

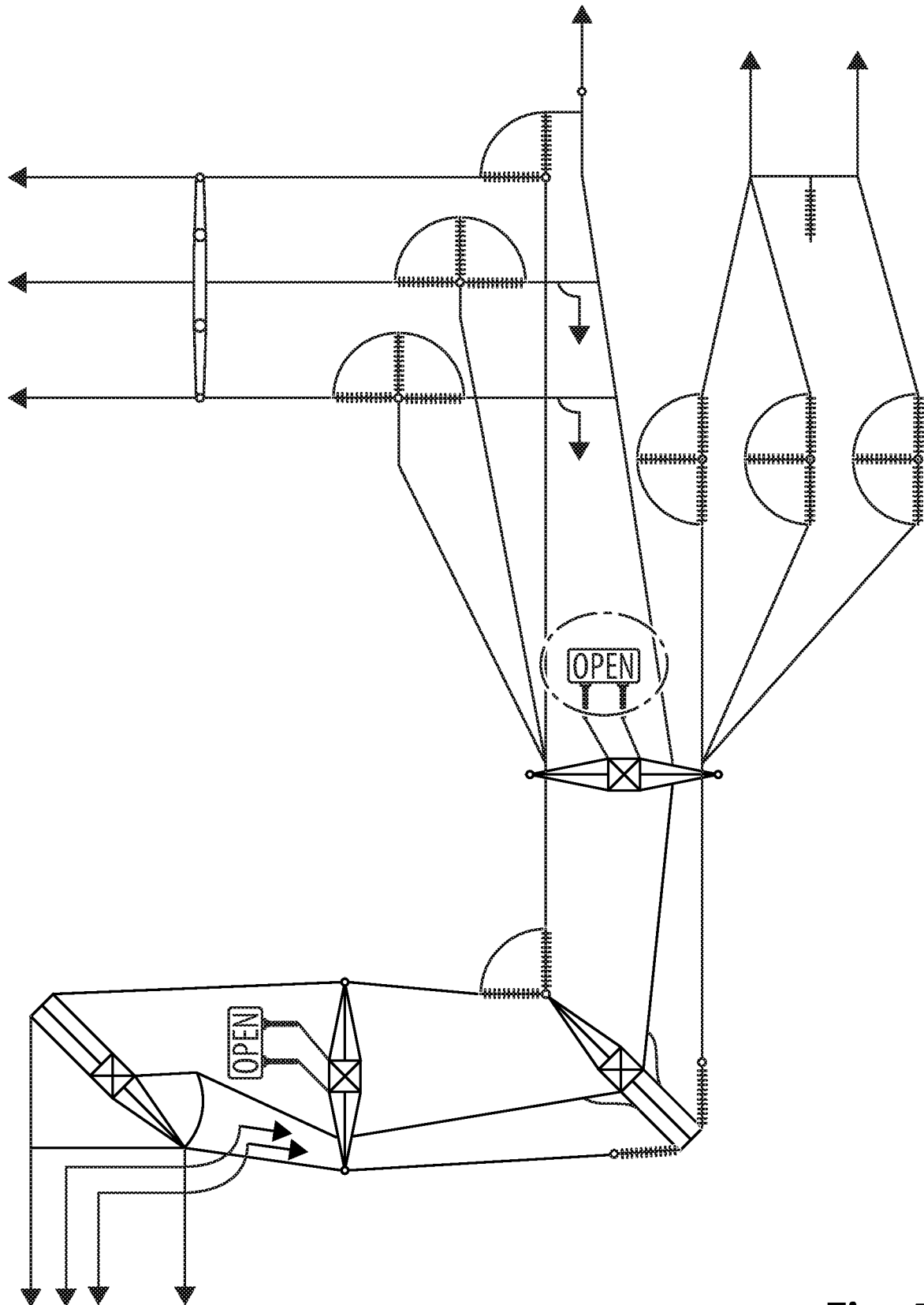


Fig. 41

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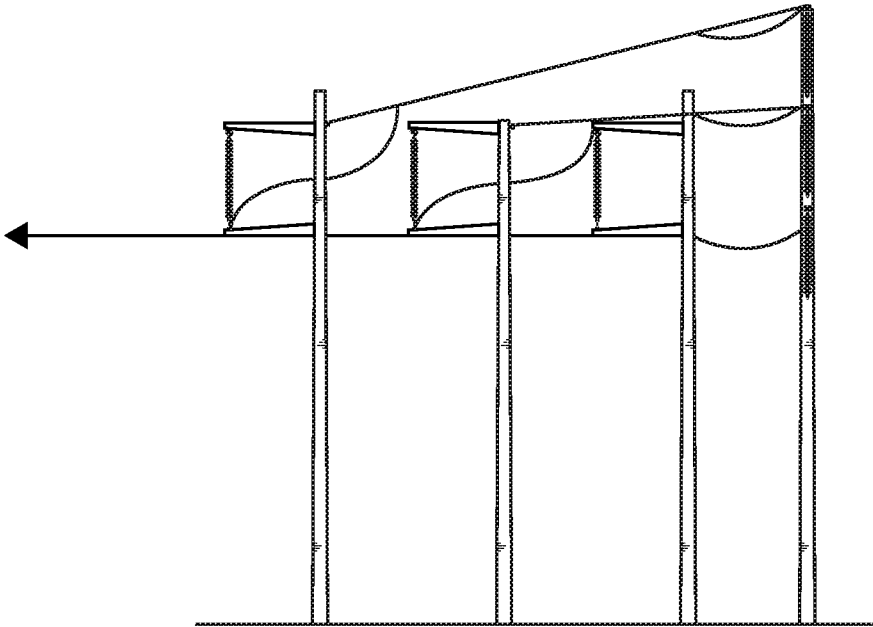


Fig. 41a

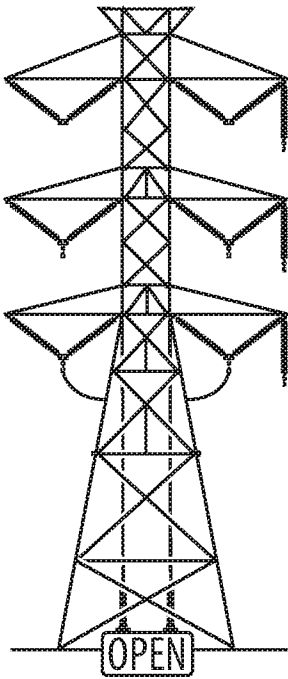


Fig. 41b

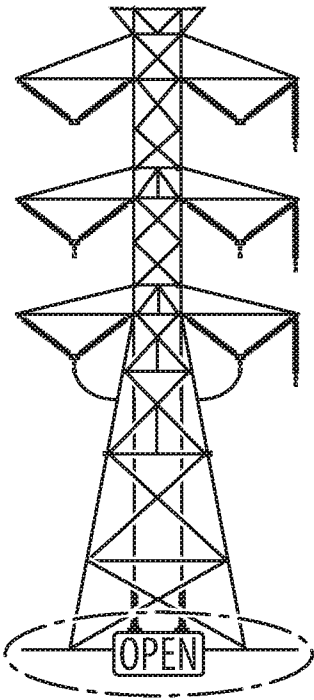


Fig. 41c

83/100

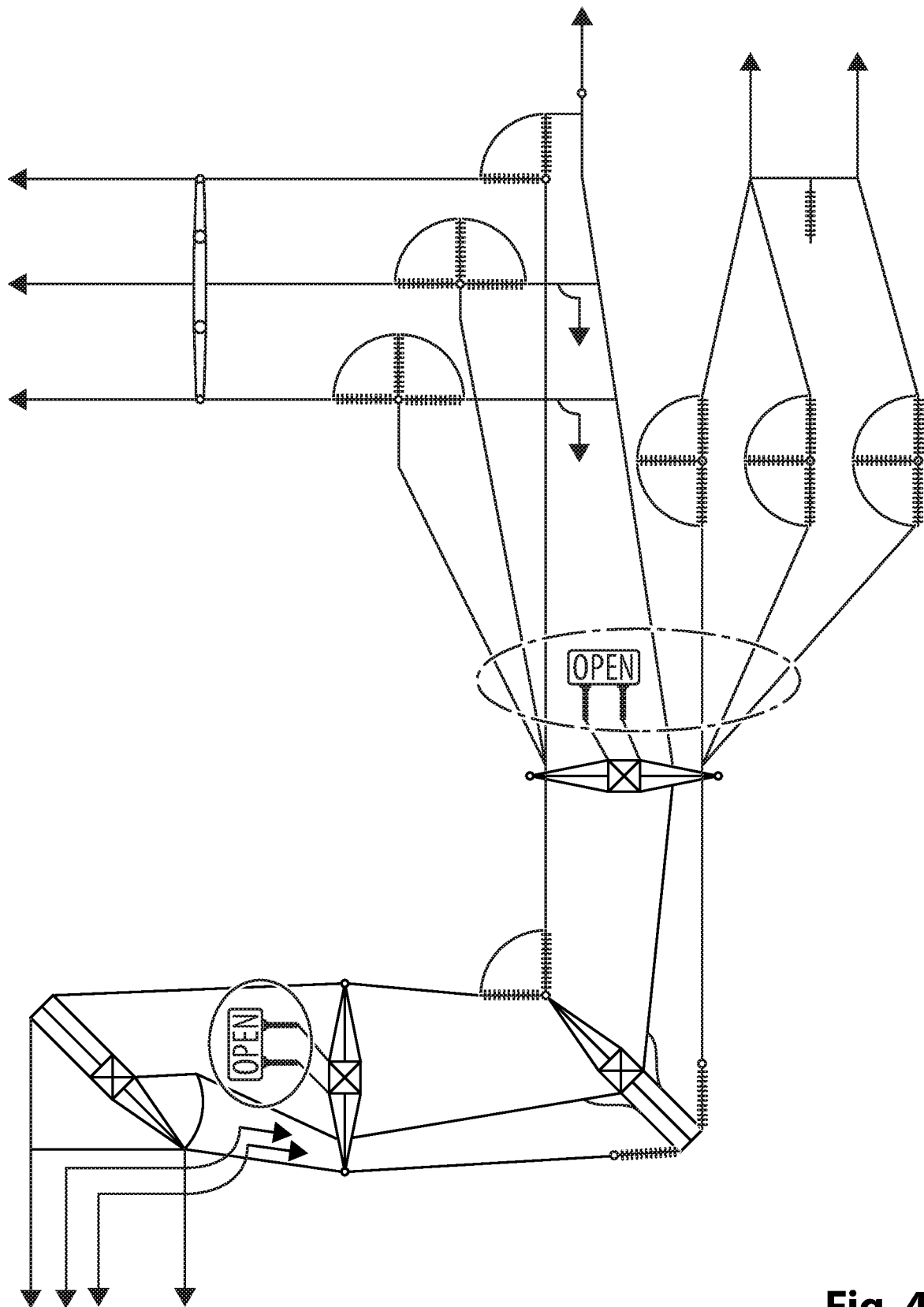


Fig. 42

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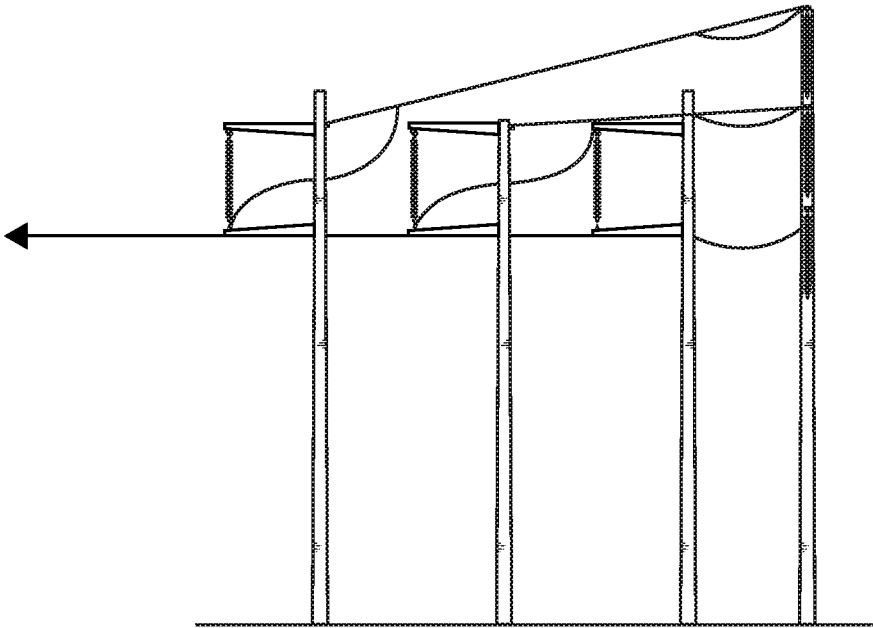


Fig. 42a

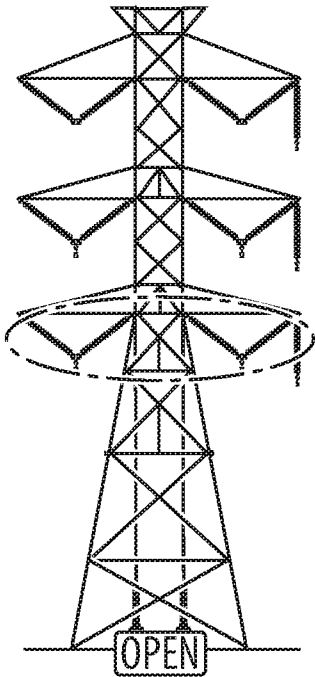


Fig. 42b

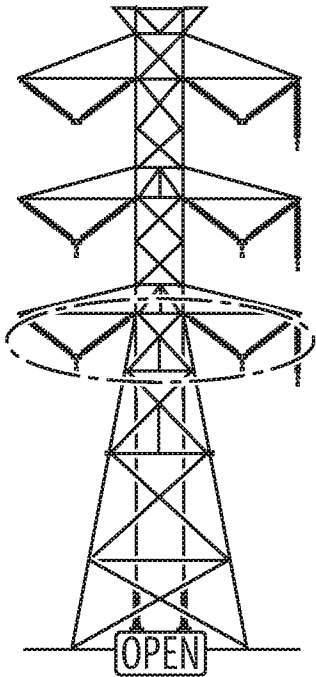


Fig. 42c

85/100

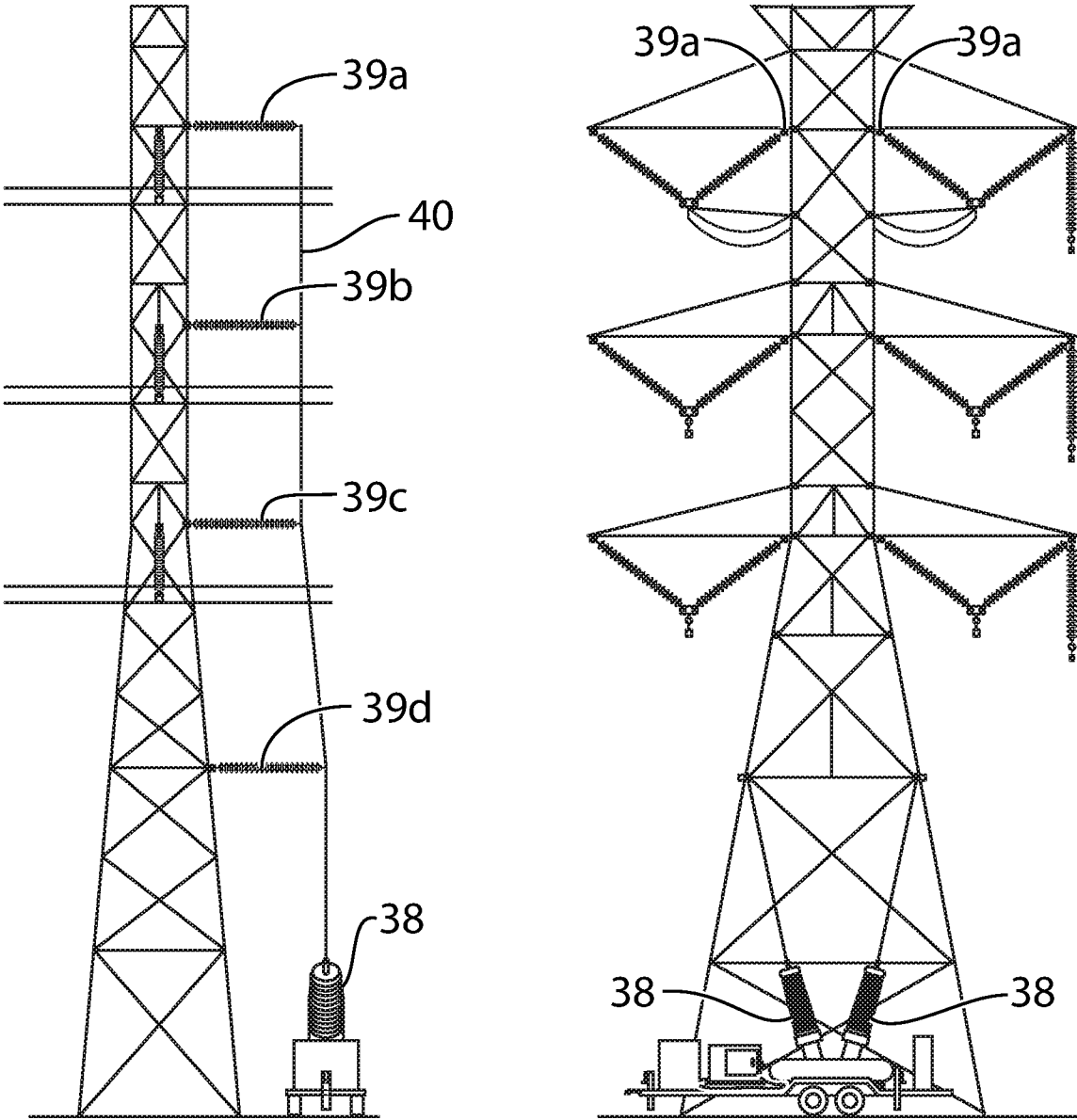


Fig. 43

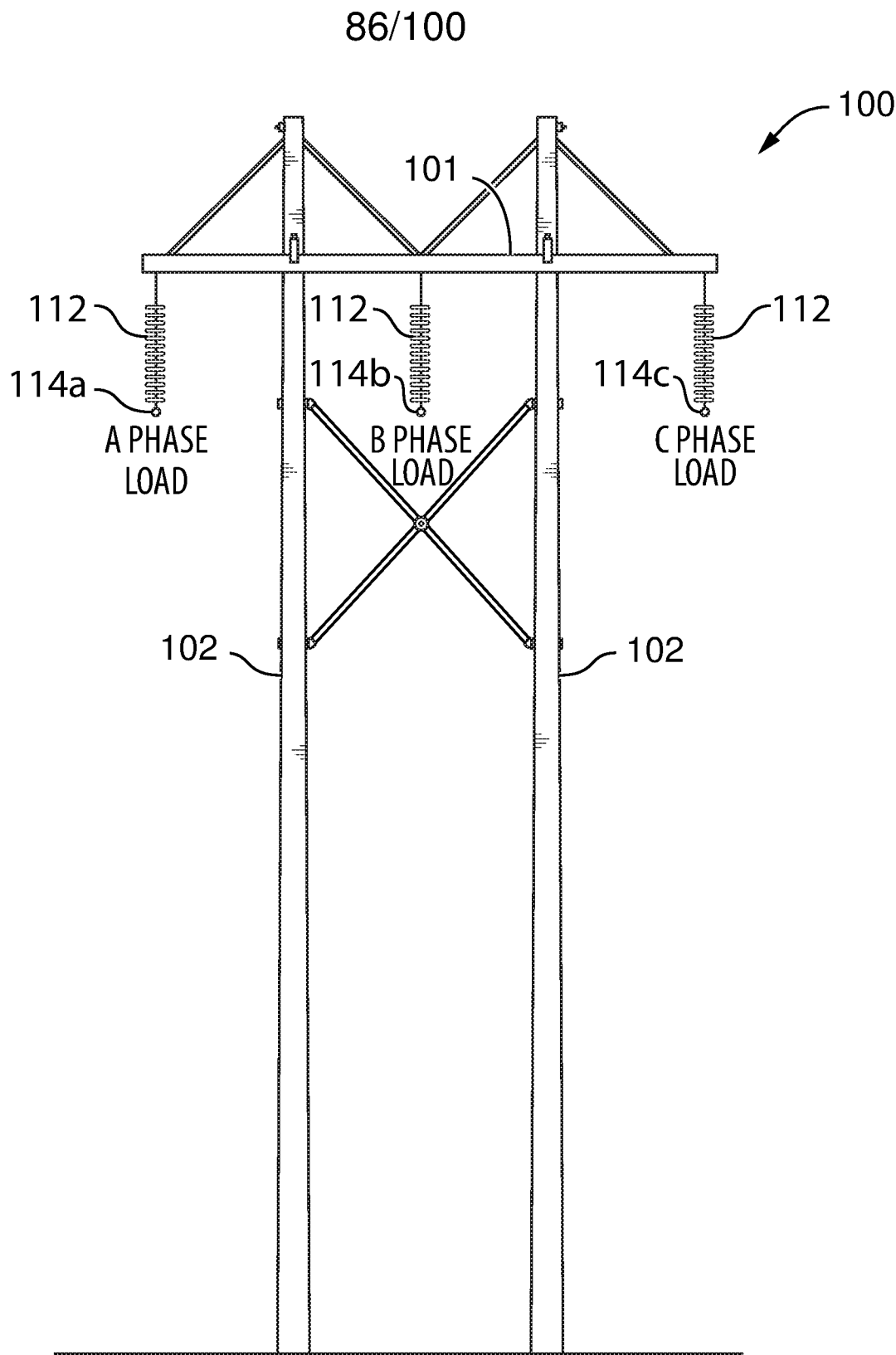


Fig. 44a

87/100

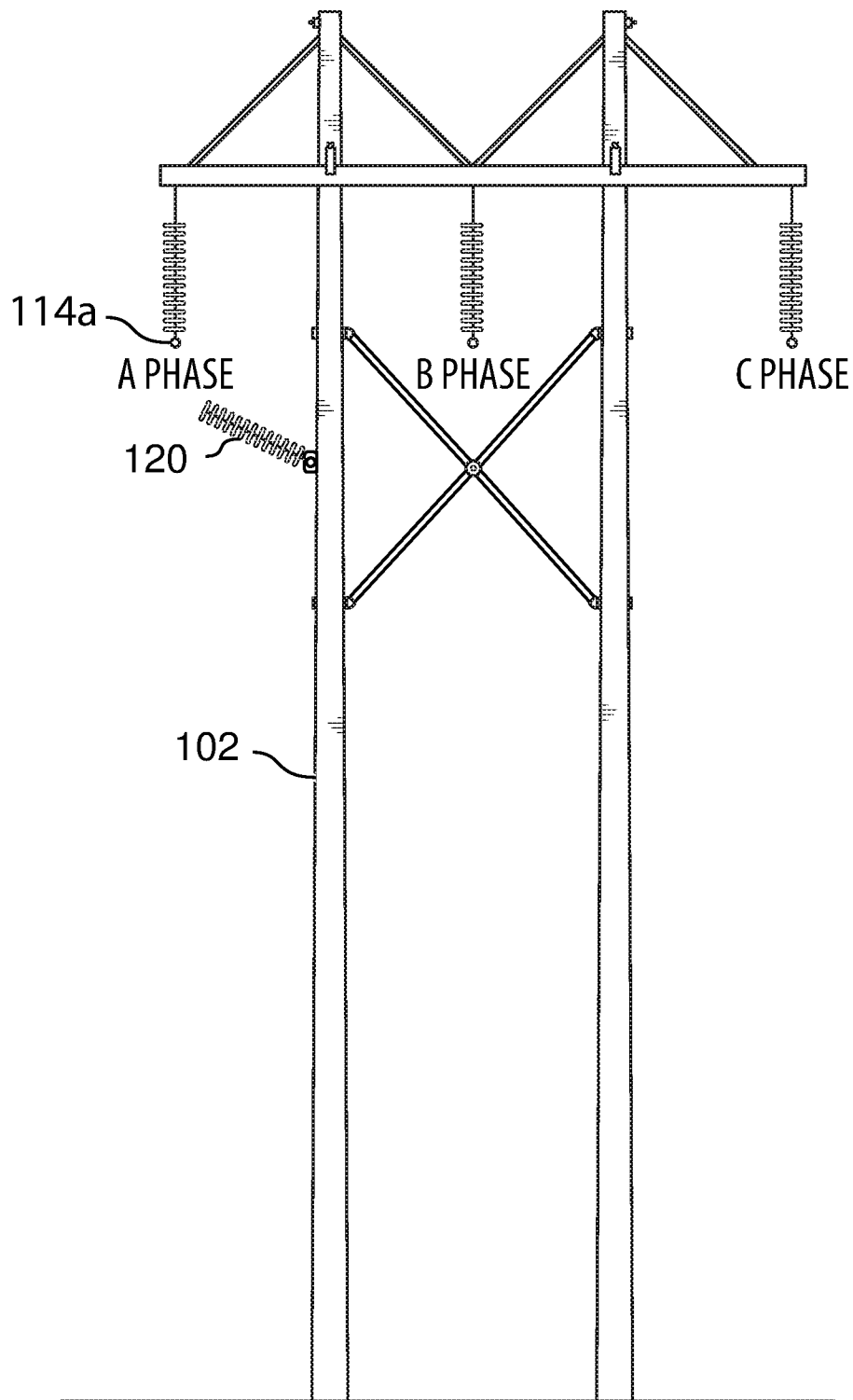


Fig. 44b

88/100

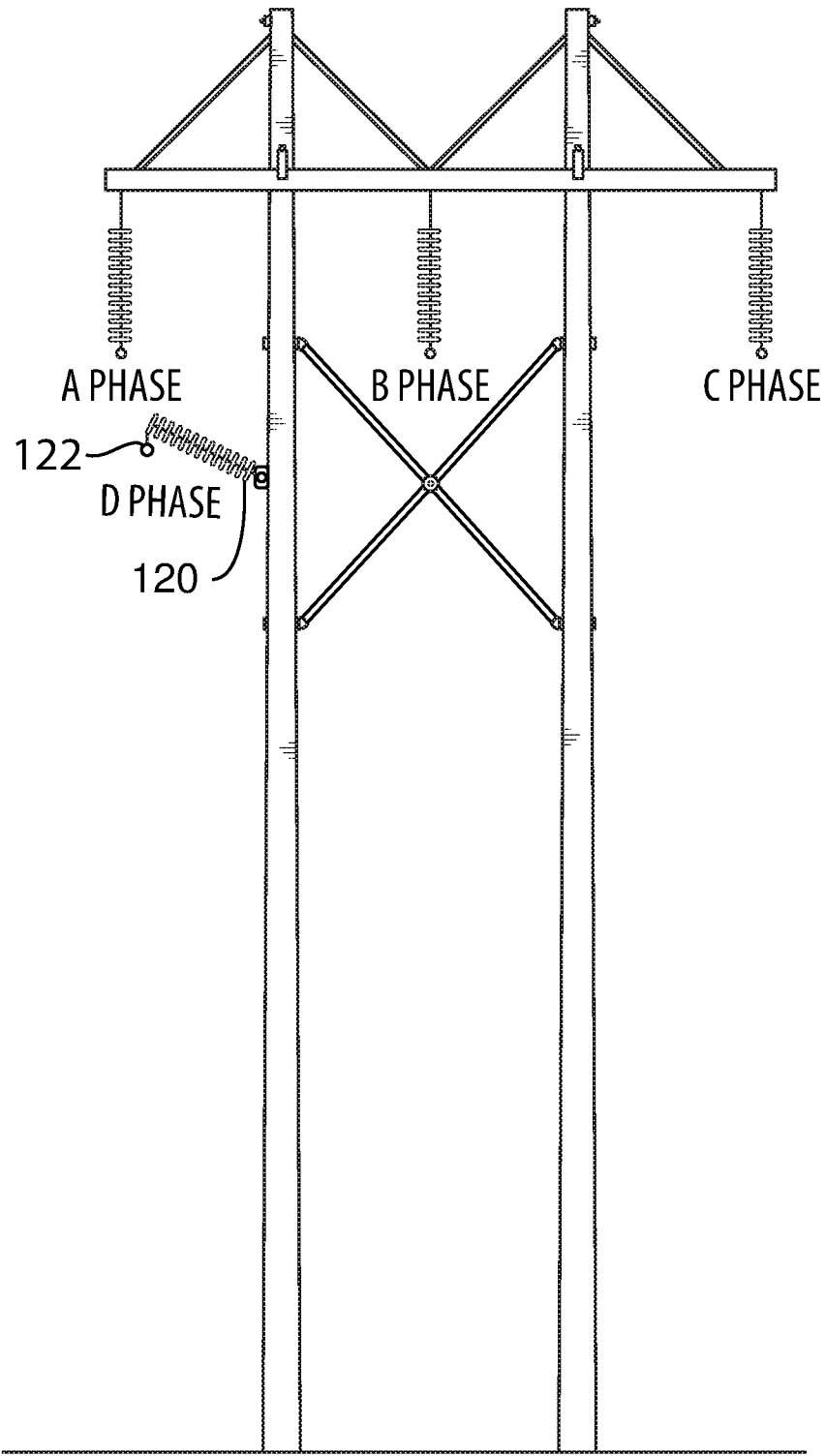


Fig. 45

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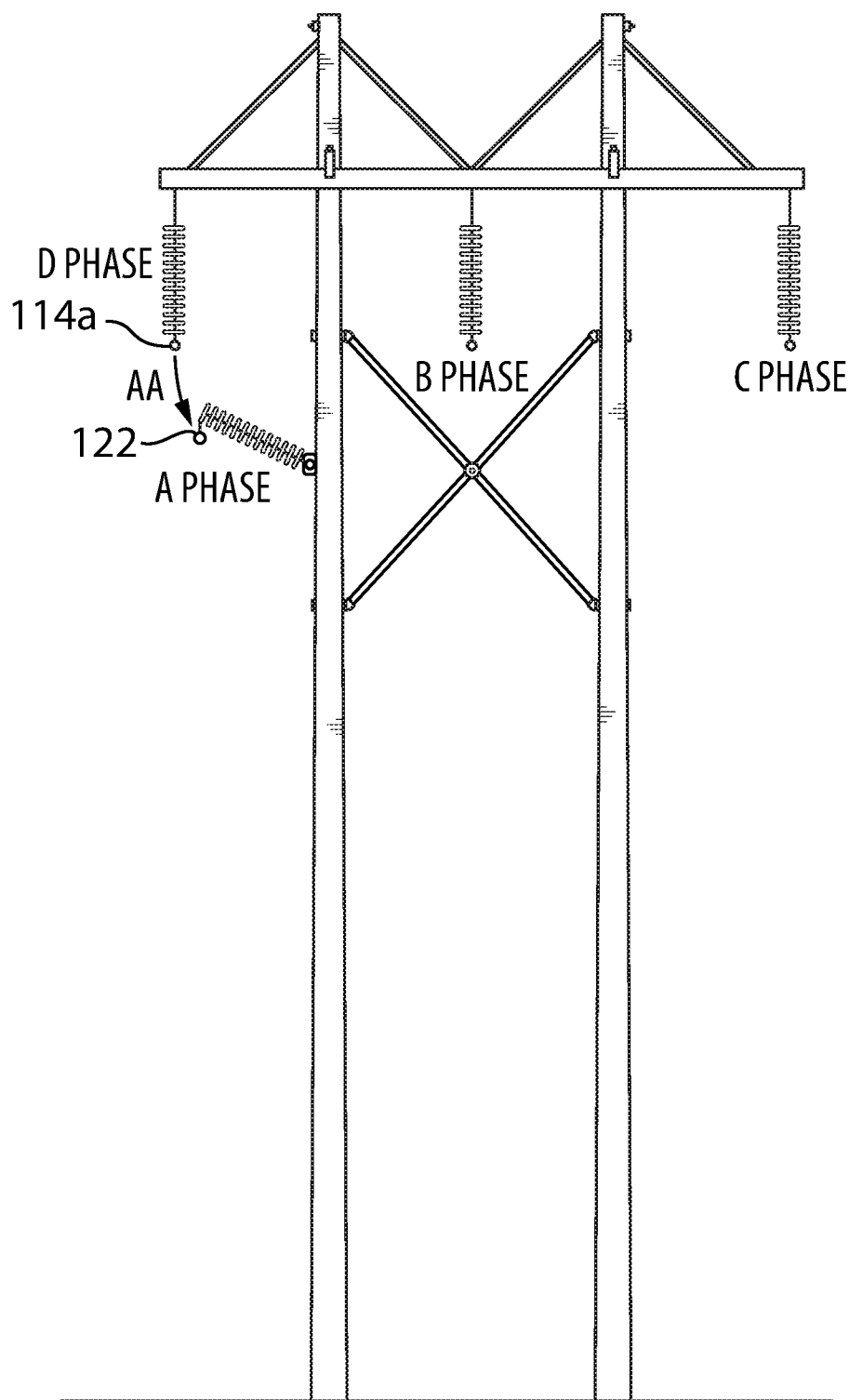


Fig. 46

90/100

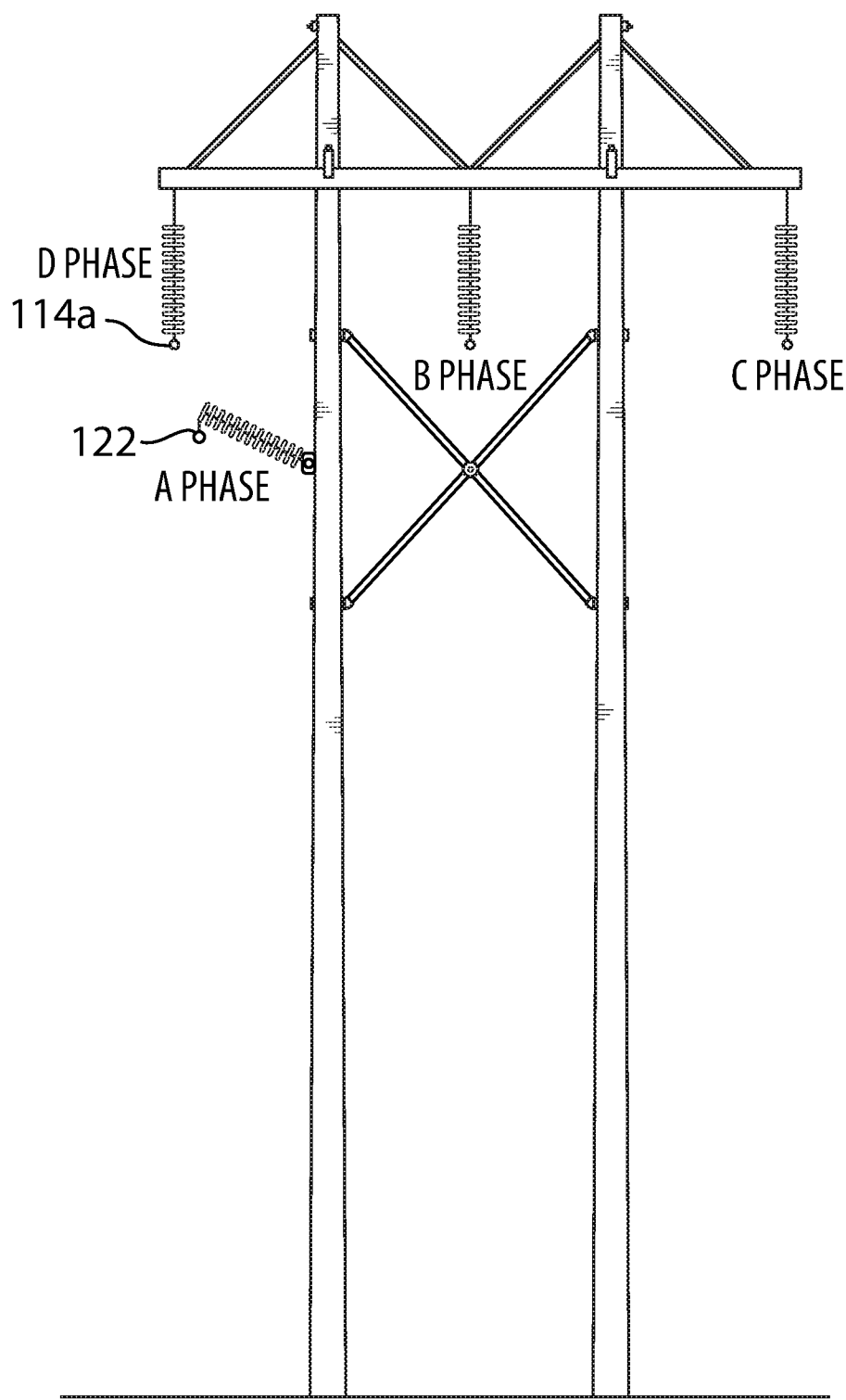


Fig. 47

91/100

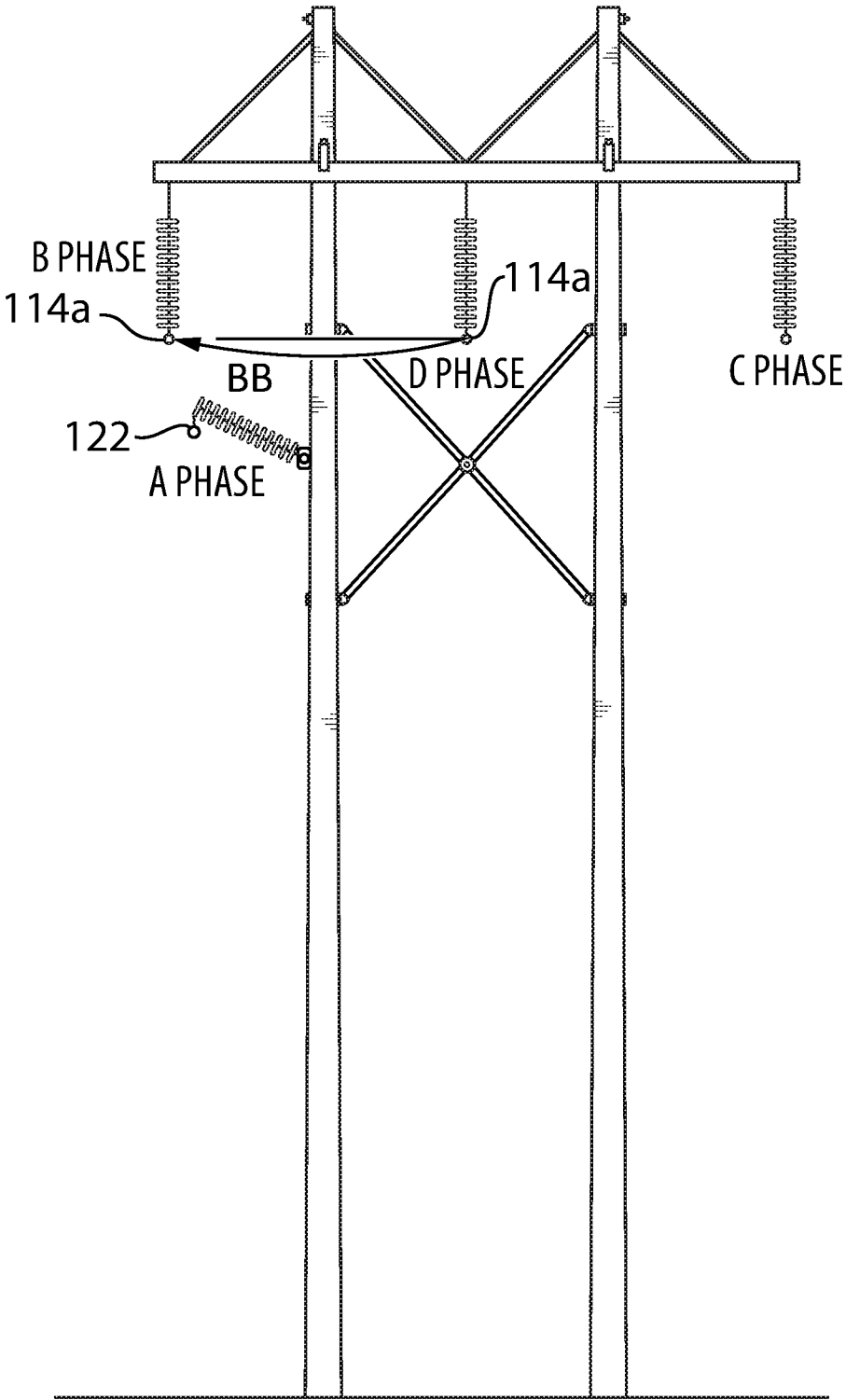


Fig. 48

92/100

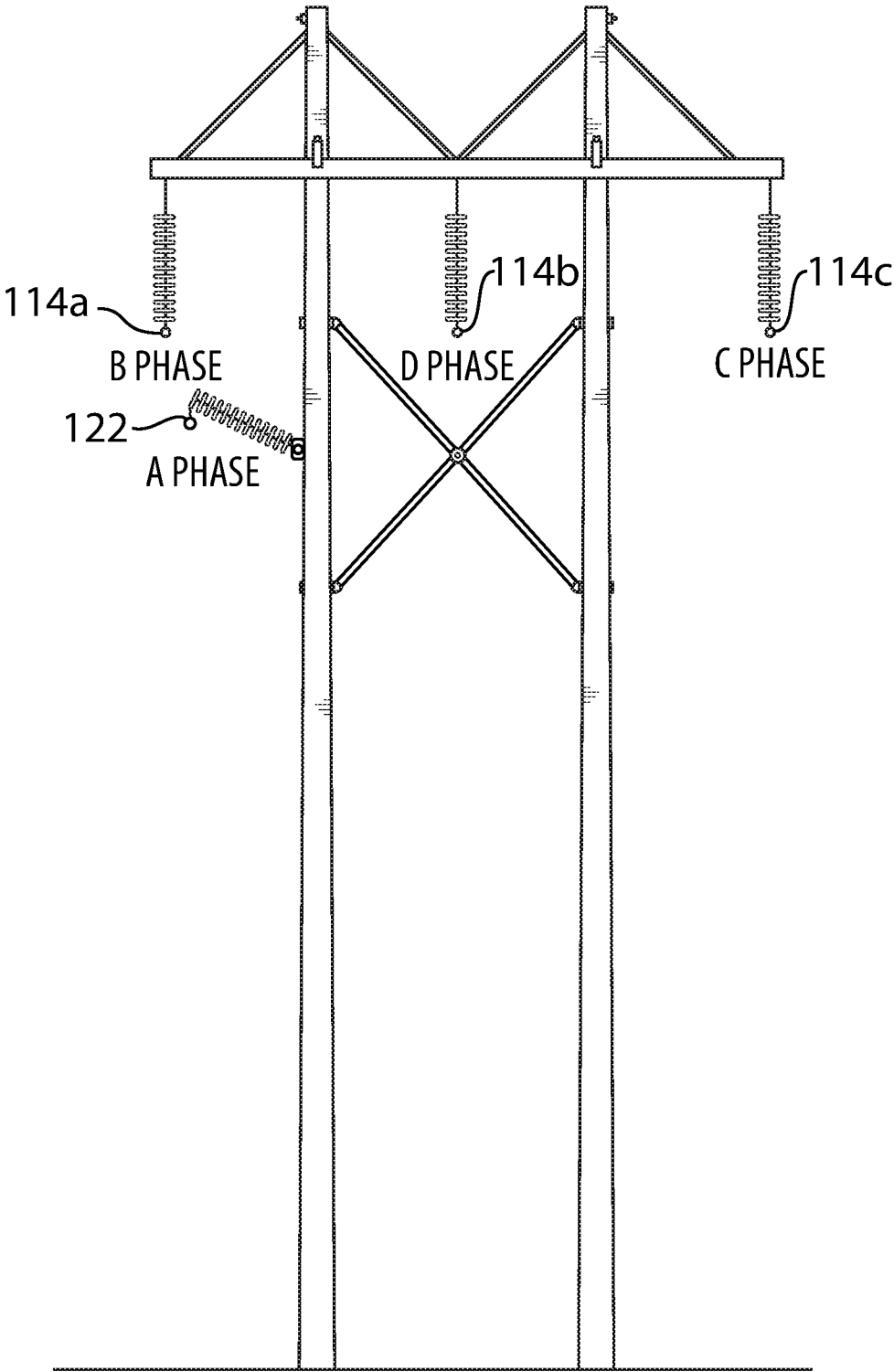


Fig. 49

93/100

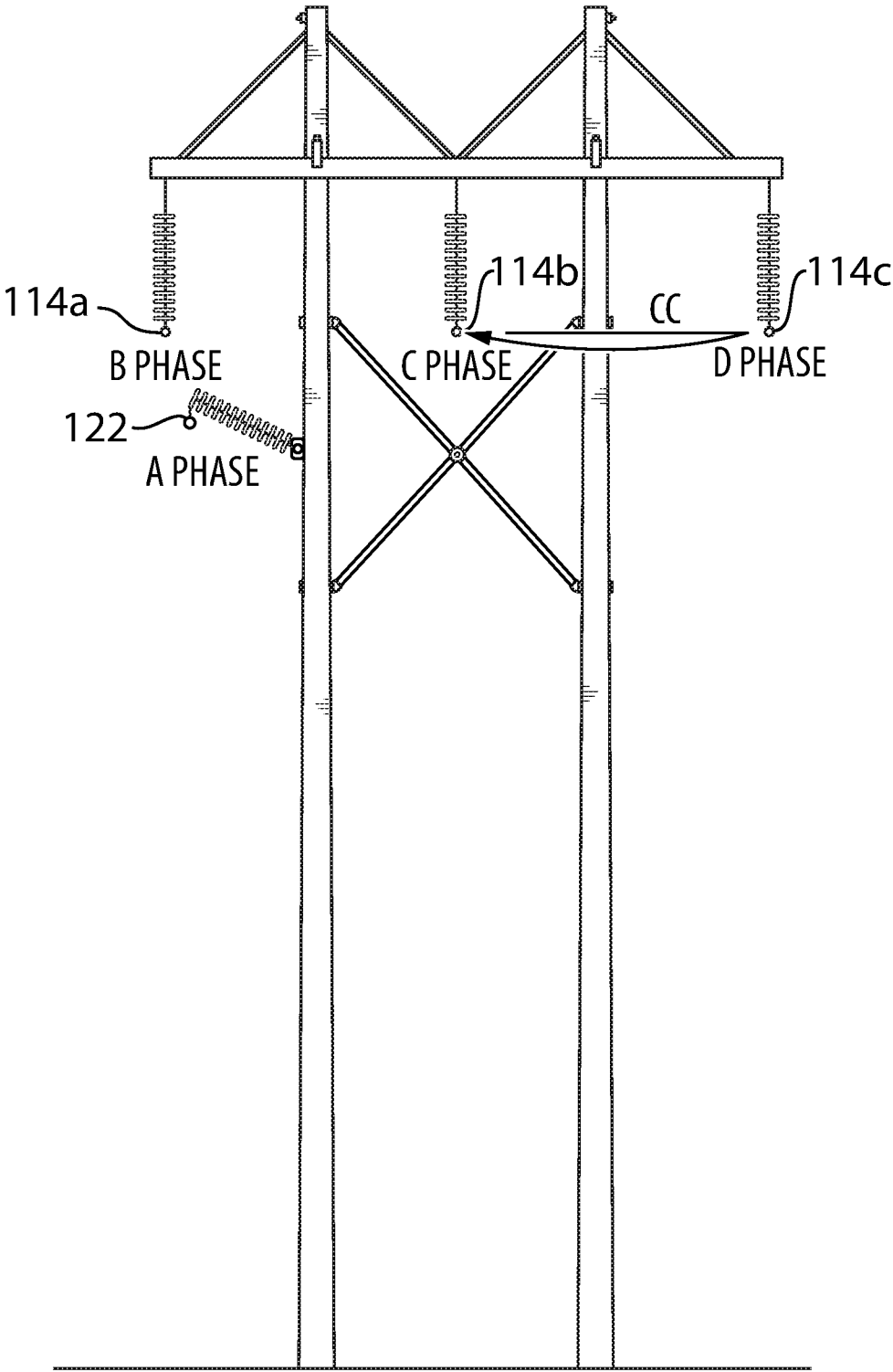


Fig. 50

94/100

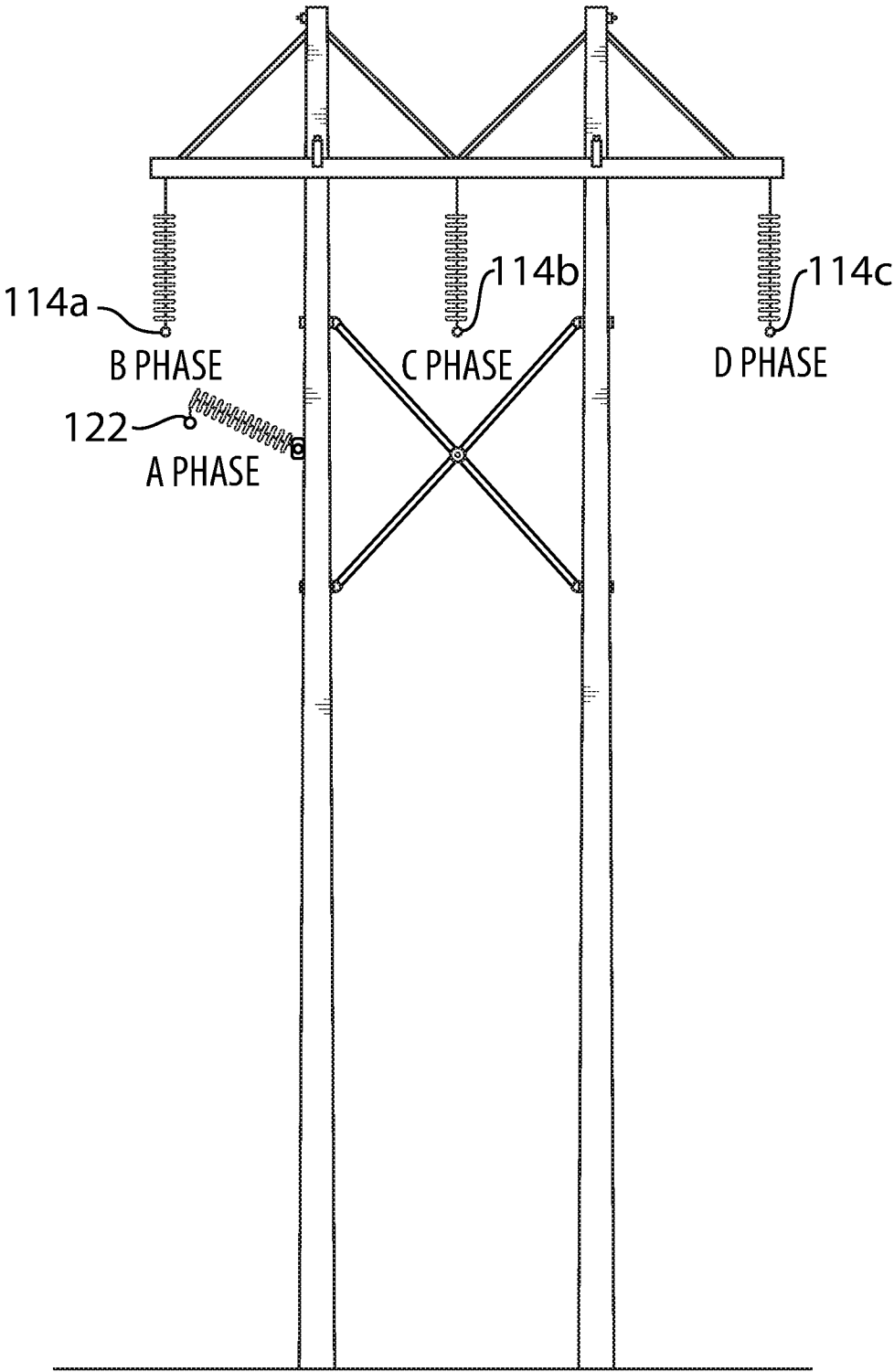


Fig. 51

95/100

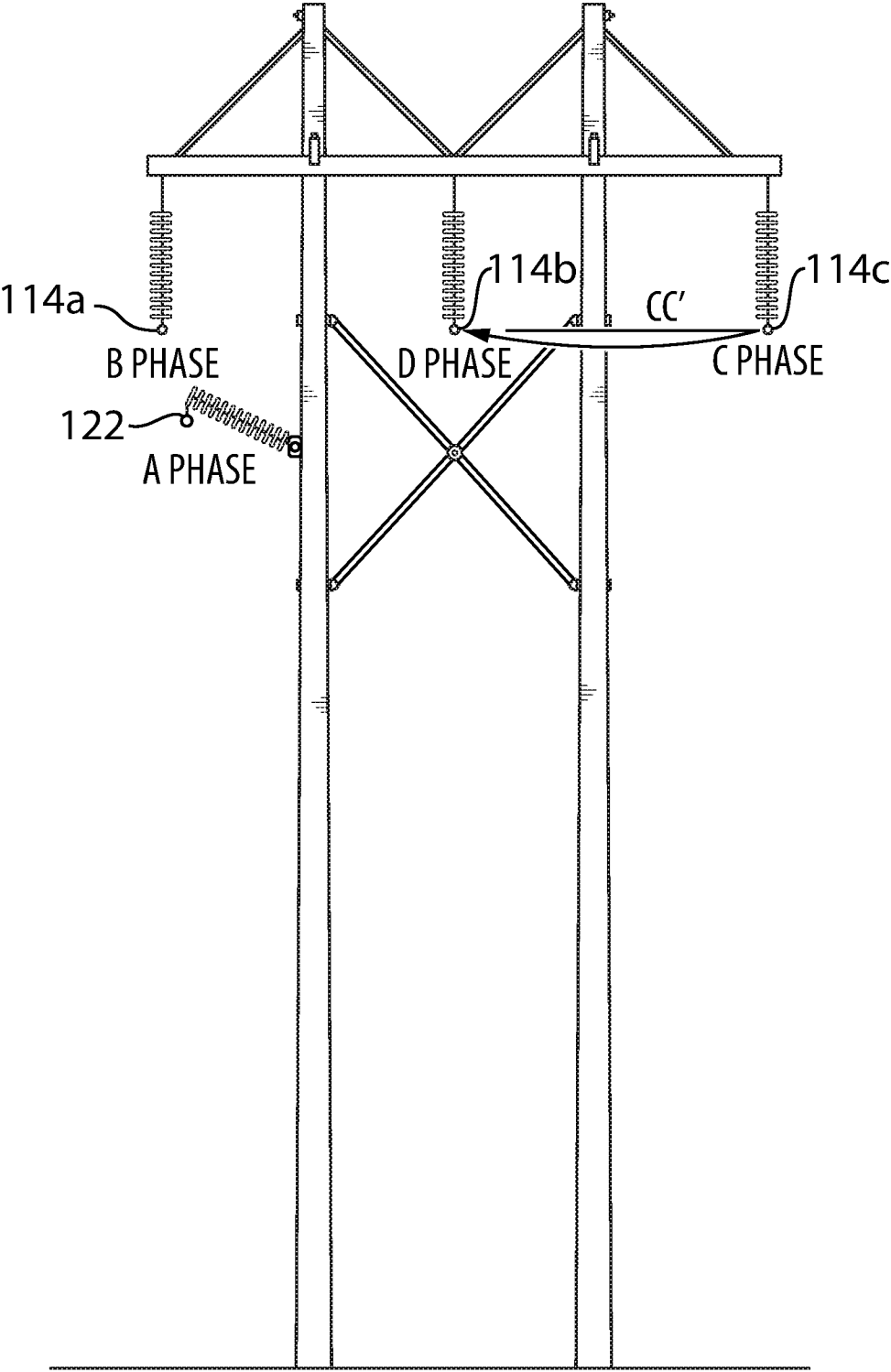


Fig. 52

96/100

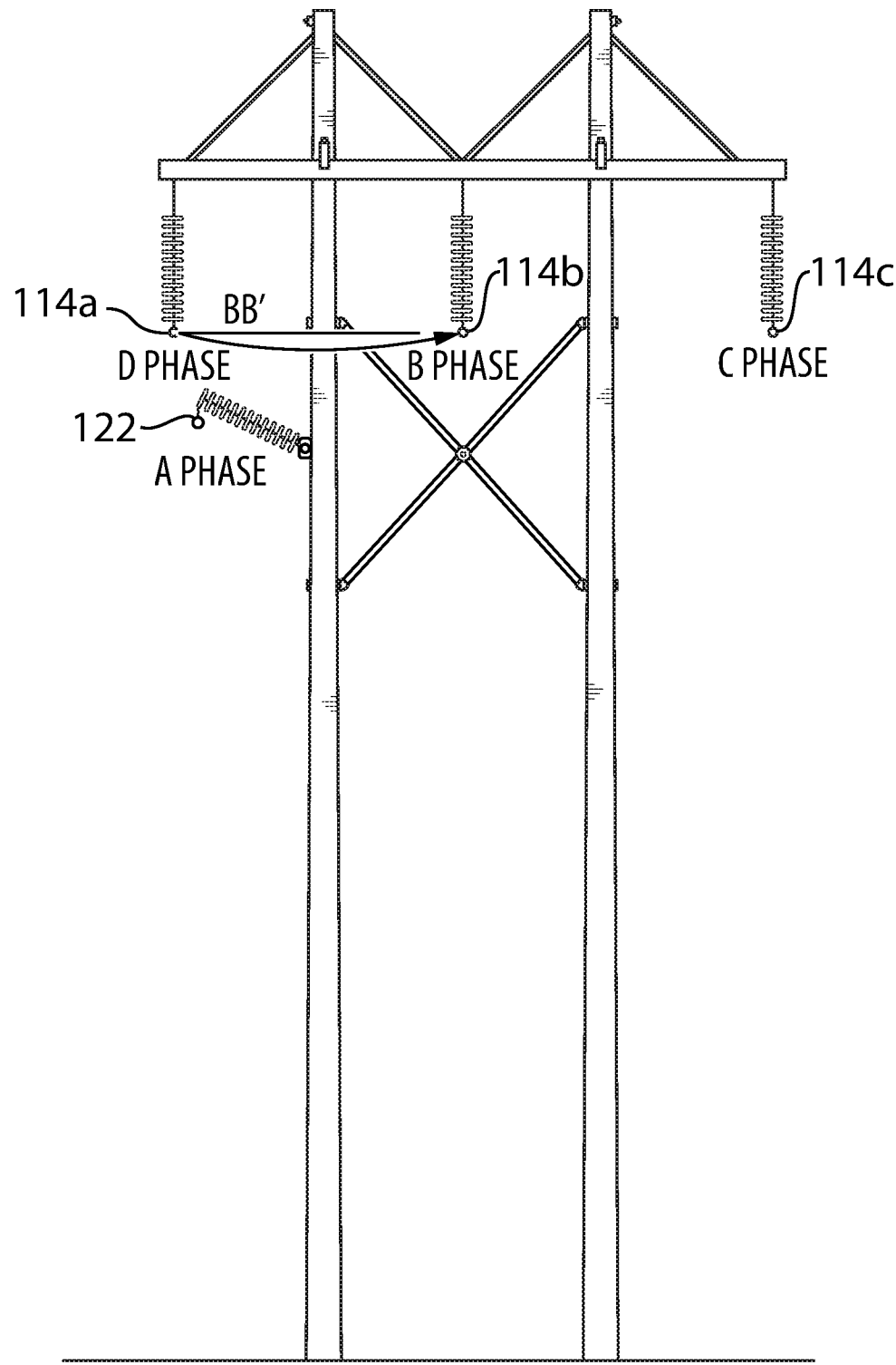


Fig. 53

97/100

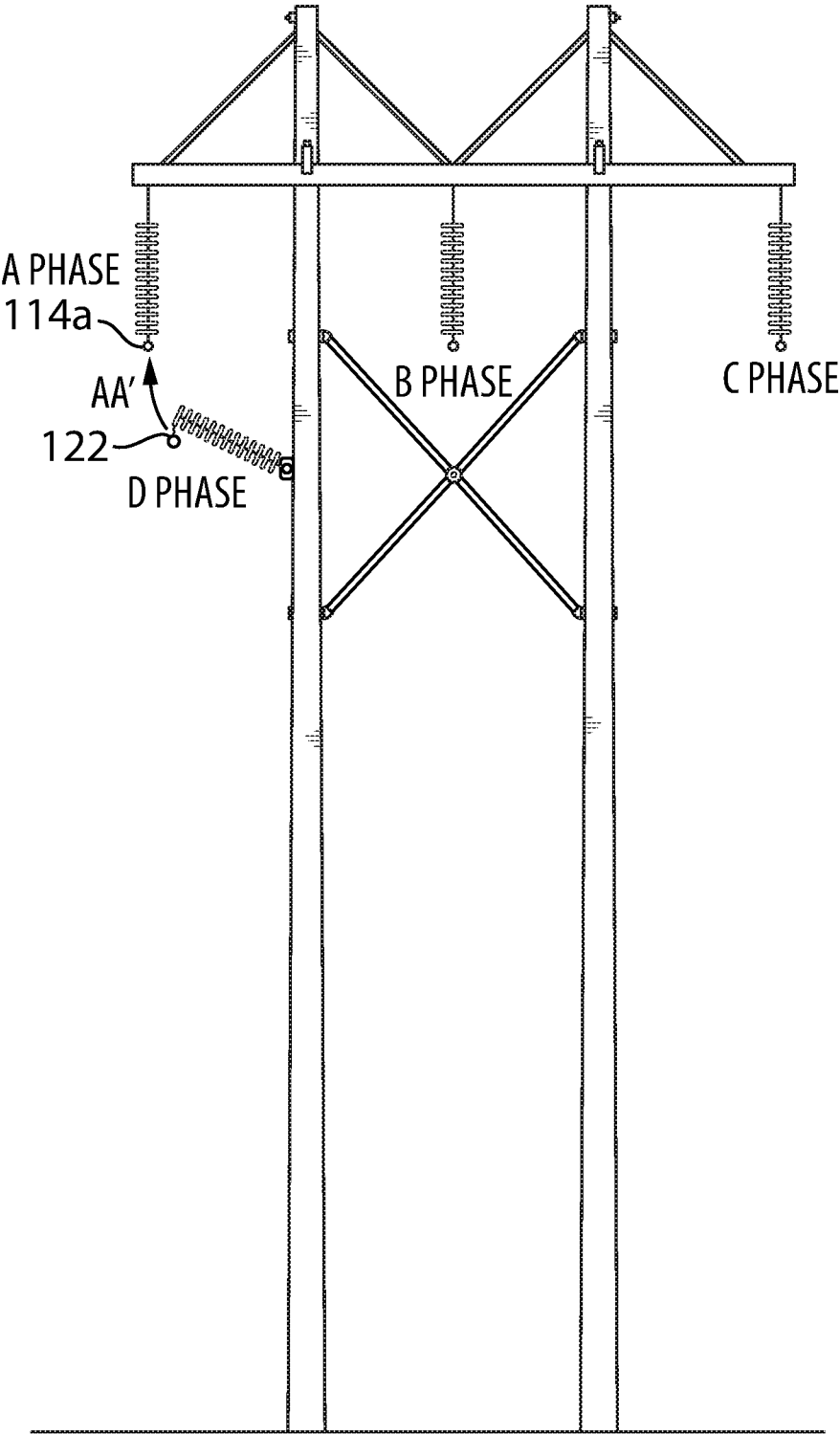


Fig. 54

98/100

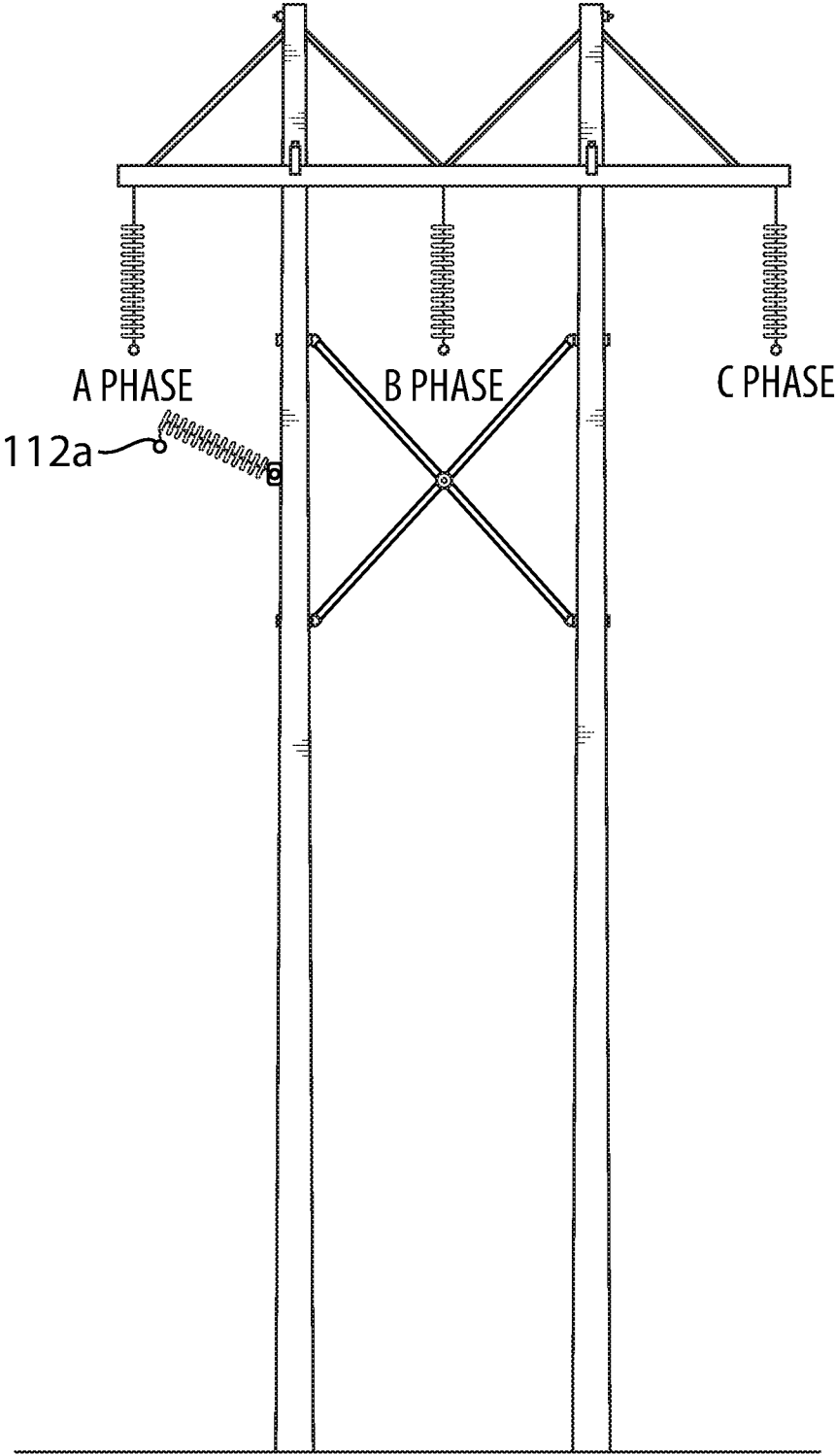


Fig. 55

99/100

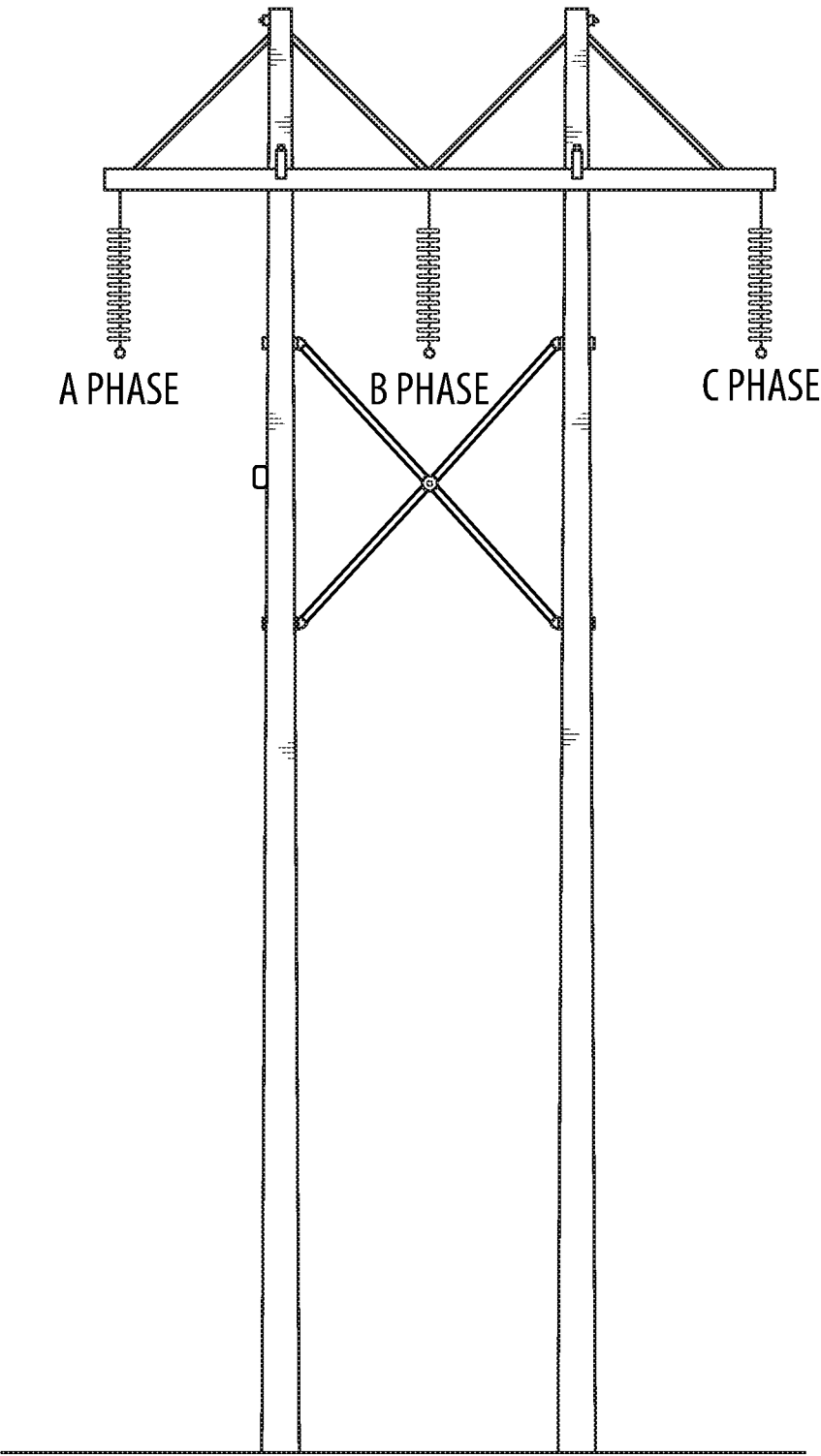


Fig. 56

100/100

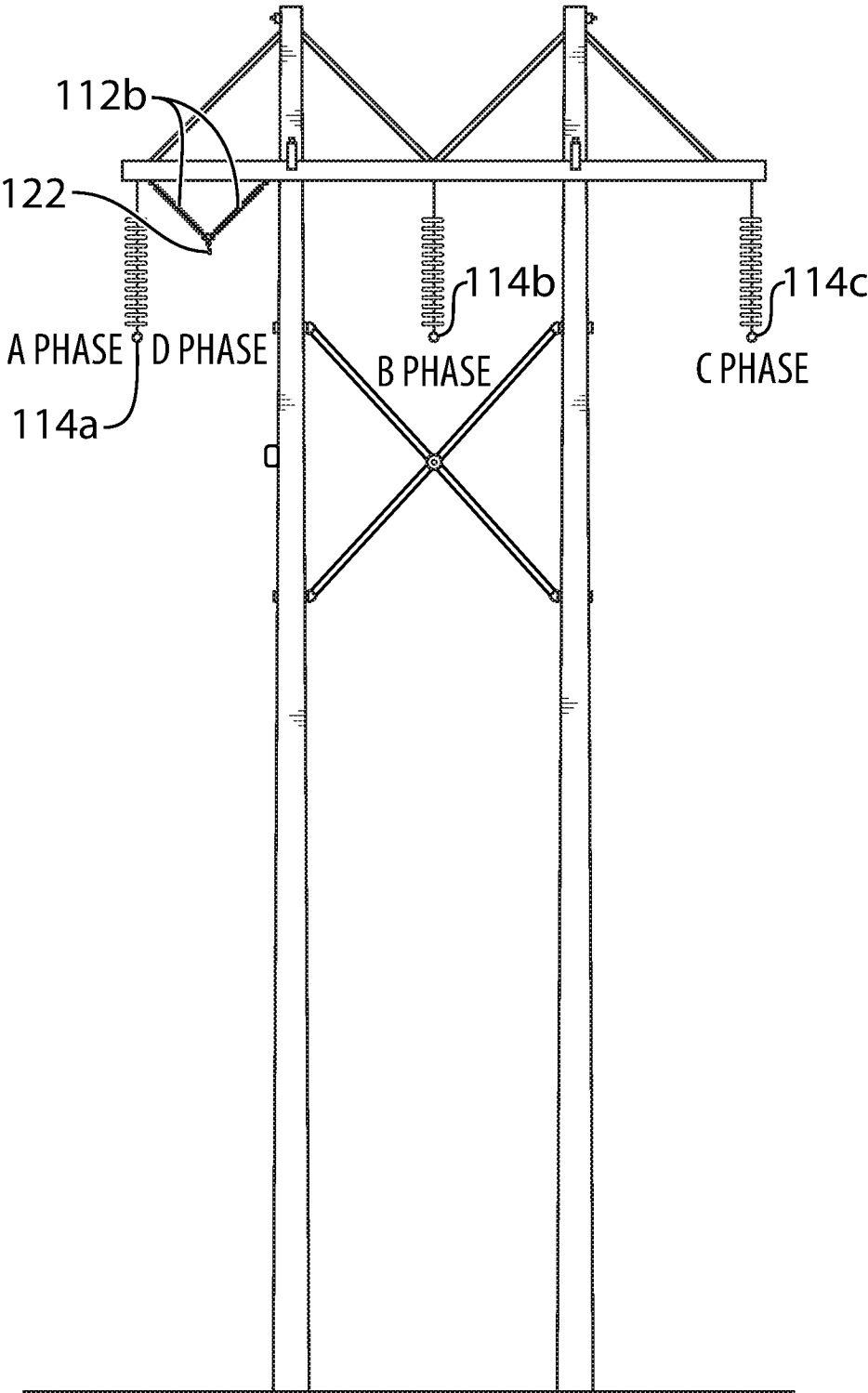


Fig. 57

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2016/026801

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H01B 7/00; H02G 1/02; H02G 1/04; H01H 50/54 (2016.01)

CPC - H02G 1/02; H02G 1/04; H01H 50/546; H01H 47/08 (2016.02)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - H01B 7/00; H02G 1/02; H02G 1/04; H01H 50/54 (2016.01)

CPC - H02G 1/02; H02G 1/04; H01H 50/546; H01H 47/08 (2016.02)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

US: 174/59; 174/68.2; 307/147 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatBase, Google Patents, ProQuest

Search terms used: conductors, temporary, energized, phase, de-energized, support, re-conductoring

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/0133244 A1 (DEVINE et al) 23 June 2005 (23.06.2005) entire document	1-6
A	US 2008/0246010 A1 (BARTHOLD) 09 October 2008 (09.10.2008) entire document	1-6
A	US 2009/0095522 A1 (BARTHOLD) 16 April 2009 (16.04.2009) entire document	1-6
A	US 2010/0133490 A1 (DEVINE et al) 03 June 2010 (03.06.2010) entire document	1-6
A	US 2003/0069657 A1 (VERDECCHIO et al) 10 April 2003 (10.04.2003) entire document	1-6

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

12 June 2016

Date of mailing of the international search report

08 JUL 2016

Name and mailing address of the ISA/

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