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Hoffend, III

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(54) **NESTED LIFT ASSEMBLIES**

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B66D 1/26	(2006.01)
A63J 1/02	(2006.01)
B66D 1/36	(2006.01)
B66D 1/39	(2006.01)

(52) **U.S. Cl.**

CPC . ***B66D 1/26*** (2013.01); ***A63J 1/028*** (2013.01); ***B66D 1/36*** (2013.01); ***B66D 1/39*** (2013.01)

(58) **Field of Classification Search**

CPC B66D 1/26; B66D 1/38; B66D 1/39; B66D 1/605; B66D 1/74; B66D 1/741; B66D 2700/0191; A63J 1/02; A63J 1/028

See application file for complete search history.

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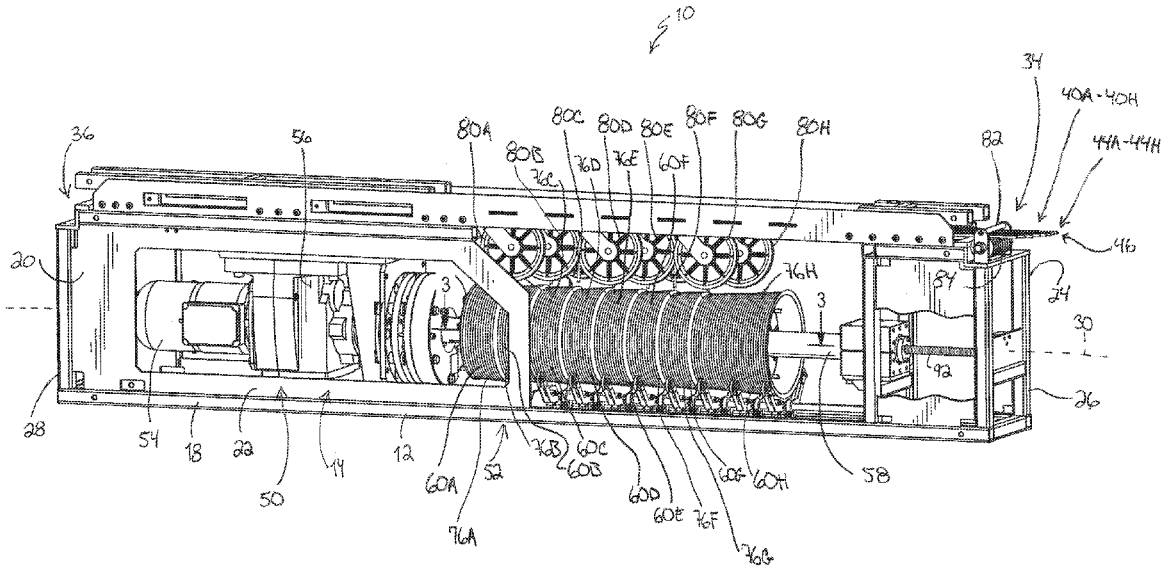
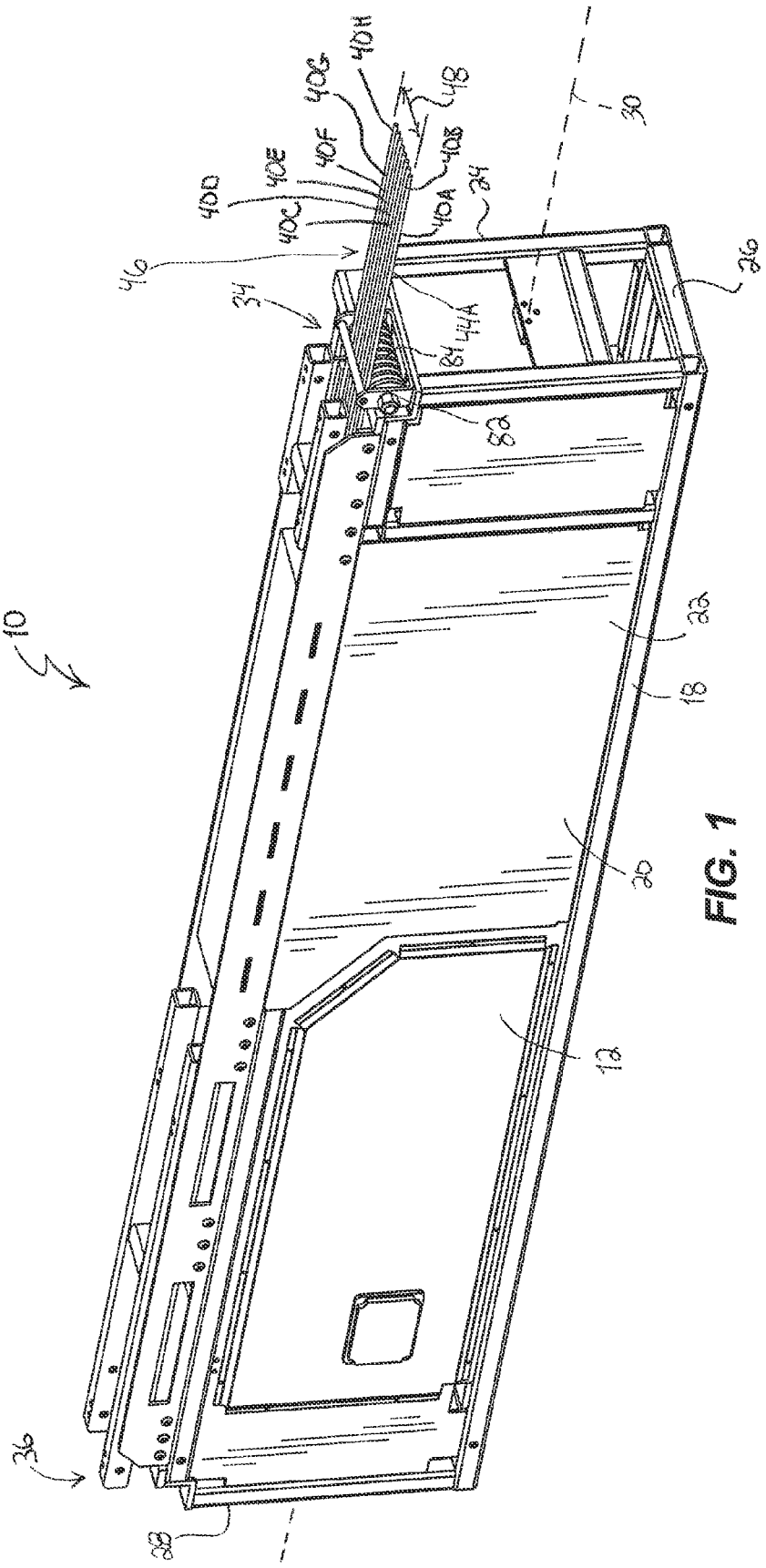
(57) **ABSTRACT**

A lift assembly that includes a base having a first side and a second side opposite the first side. The base defines an outlet positioned closer to the first side than to the second side. The lift assembly further includes a take-up mechanism mounted to the base, and a cable having a stored portion on the take-up mechanism and a free portion extending from the take-up mechanism through the outlet.

9 Claims, 7 Drawing Sheets

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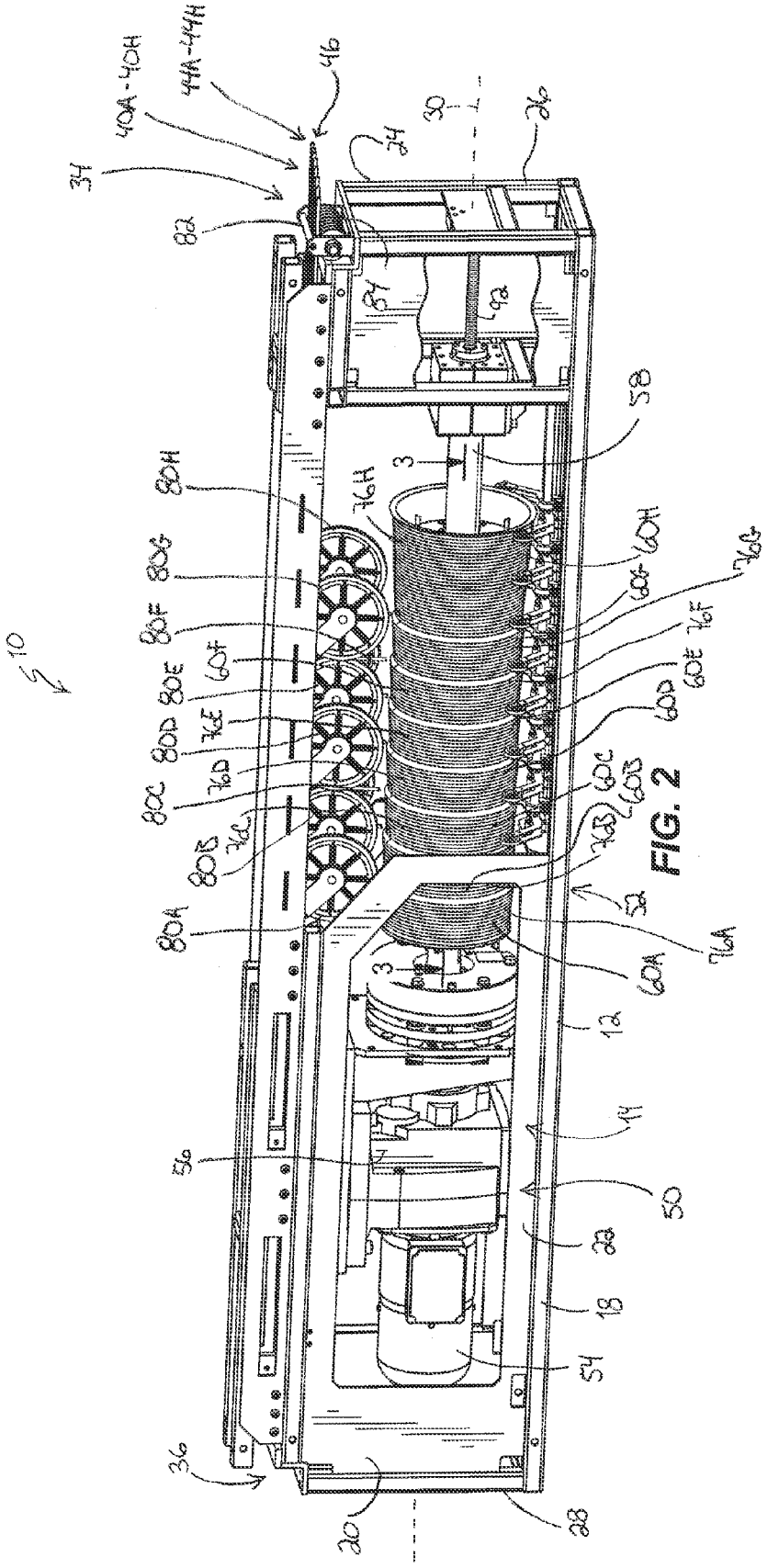
40A
40B
40C
40D
40E
40F
40G
40H
42
44
44A
46
48

FIG. 1


10
40A-40H
44A-44H
46
34
82
24
30
26
84
86
58
3
80H
76H
60H
80G
76G
80F
60F
76F
80E
60E
80D
76E
60D
76D
80C
60C
80B
76C
60B
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80A
52
76A
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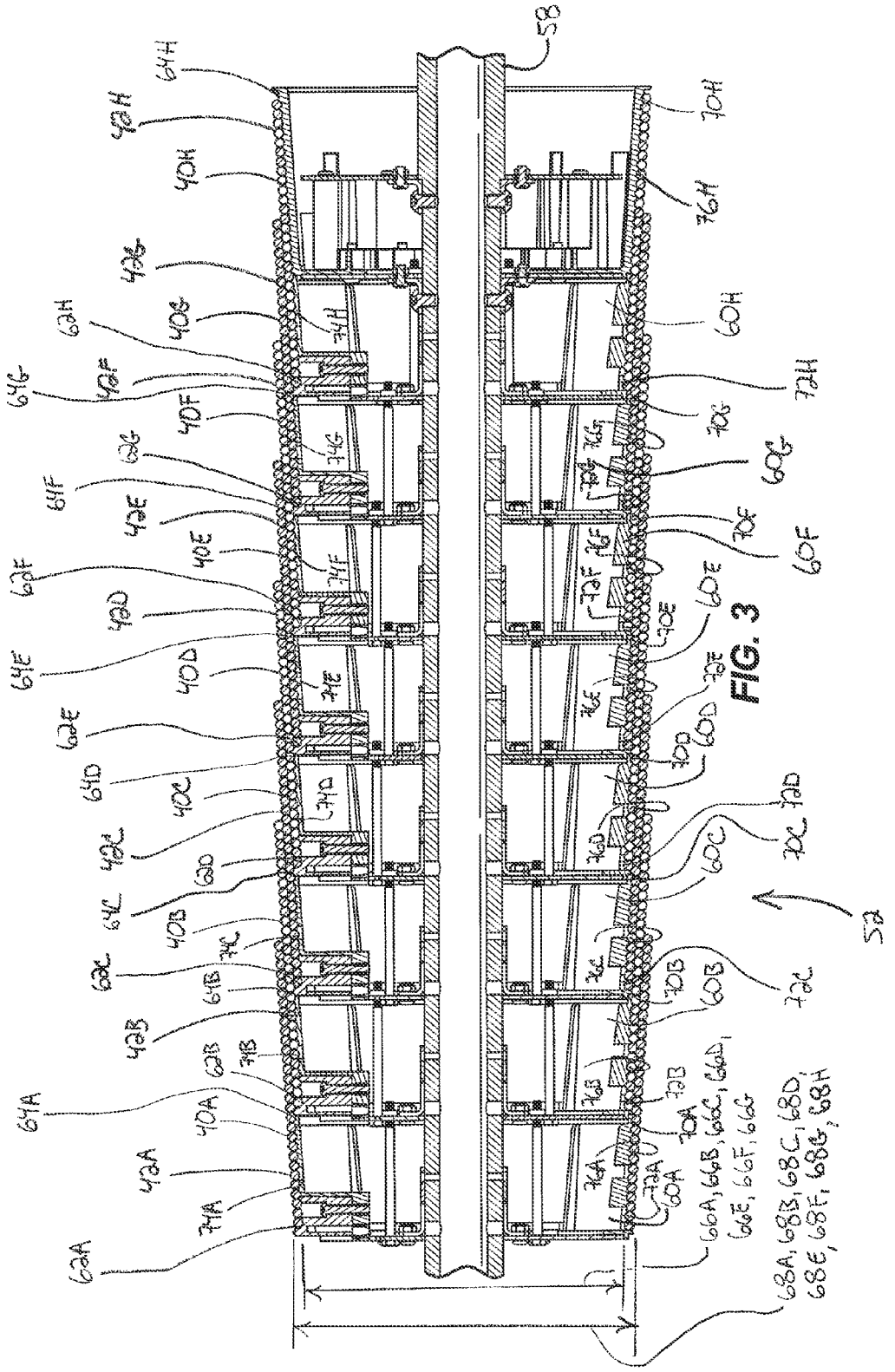
12
14
56
50
28
18
54
36
20

FIG. 2


58
64H
40H
42H
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60H
70H
76H
72H
64G
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42G
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64F
40F
42F
44F
60F
70F
74F
64E
40E
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44E
60E
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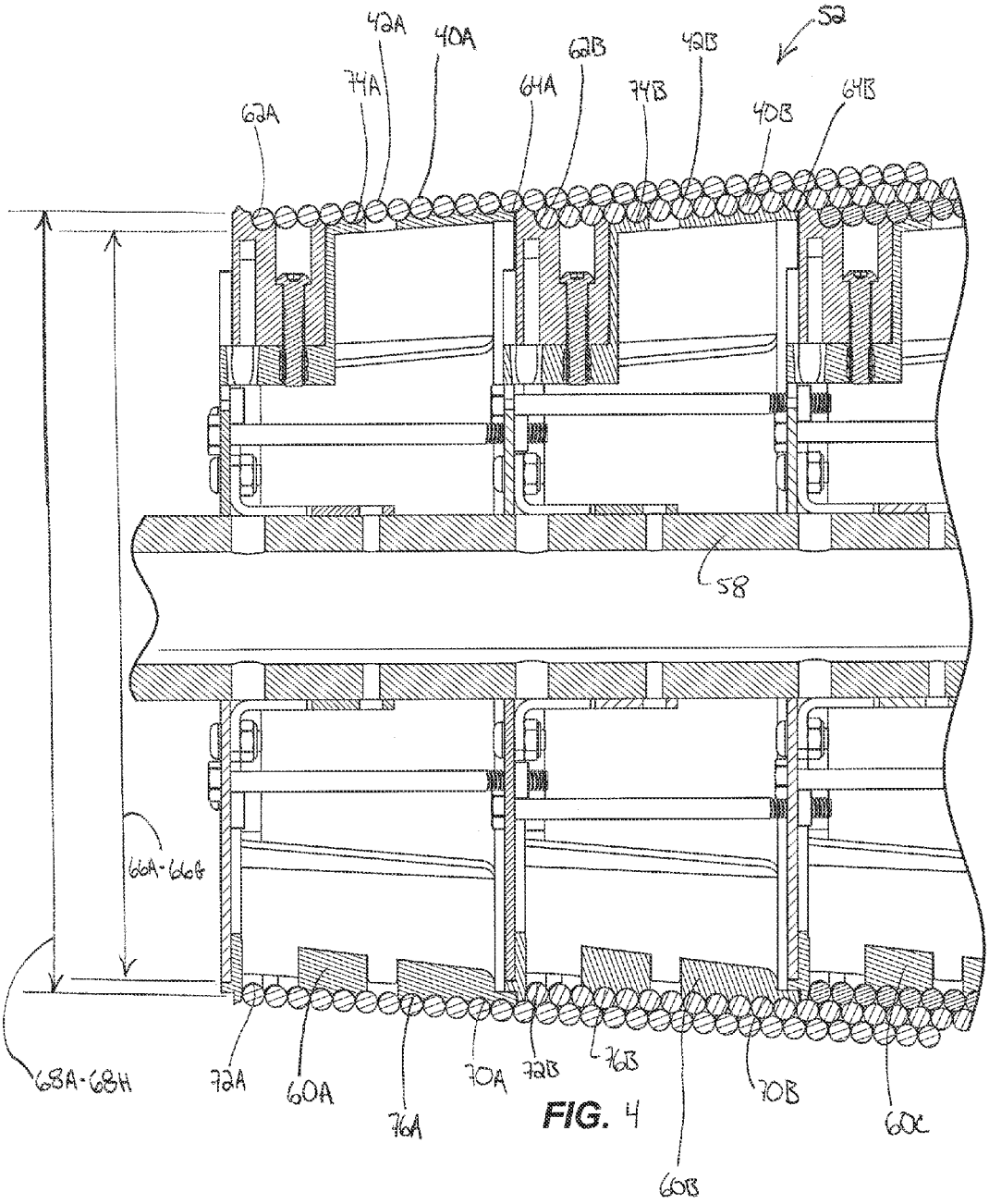
74E
64D
40D
42D
44D
60D
70D
74D
64C
40C
42C
44C
60C
70C
74C
64B
40B
42B
44B
60B
70B
74B
64A
40A
42A
44A
60A
70A
74A
62A
66A, 66B, 66C, 66D, 66E, 66F, 66G
68A, 68B, 68C, 68D, 68E, 68F, 68G, 68H
X
Y

FIG. 3


42A
40A
74A
62B
64A
42B
74B
52
62A
40B
64B
58
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68A-68H
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70A
72B
76B
60B
70B
60C

FIG. 4

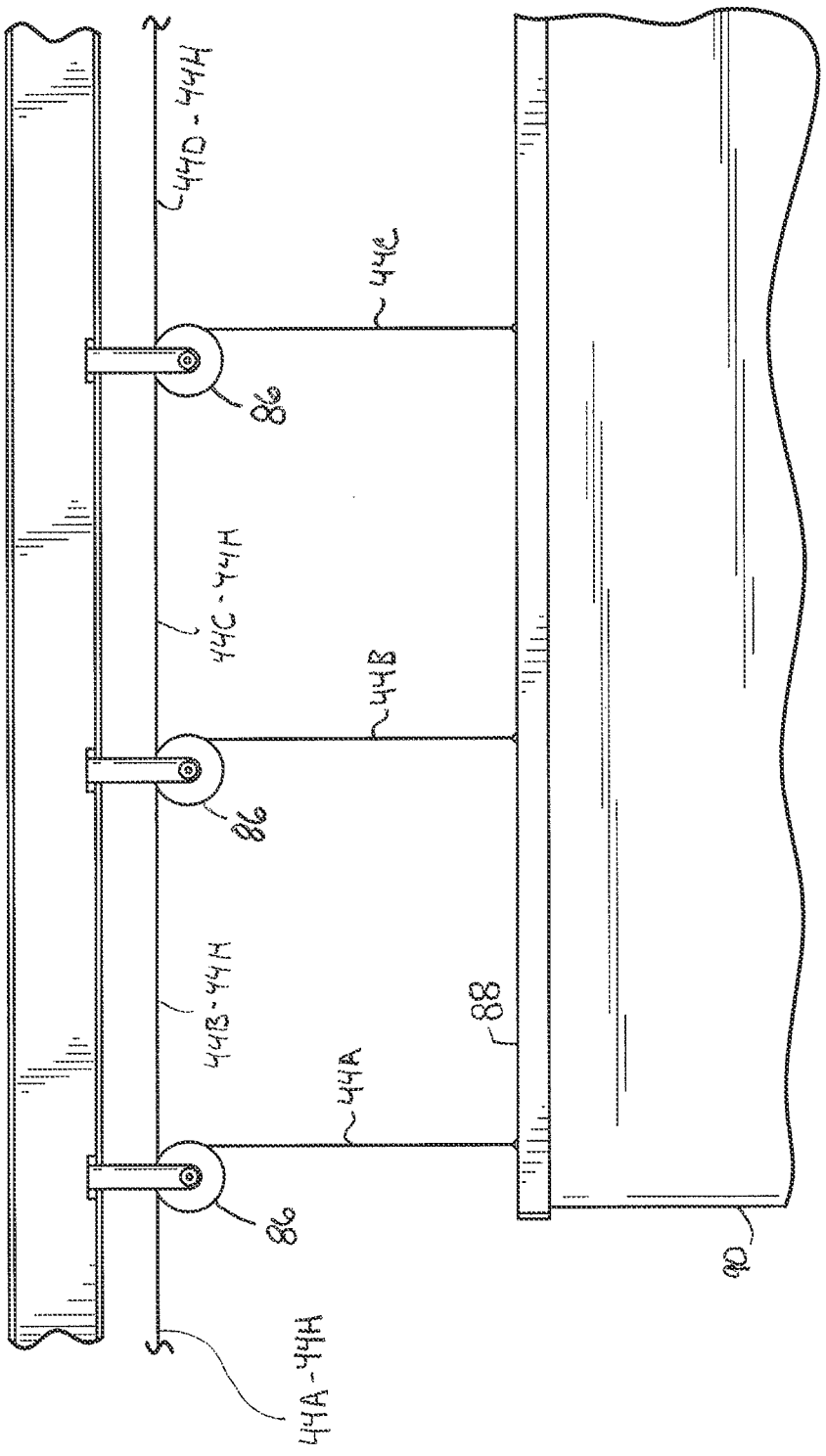

FIG. 5

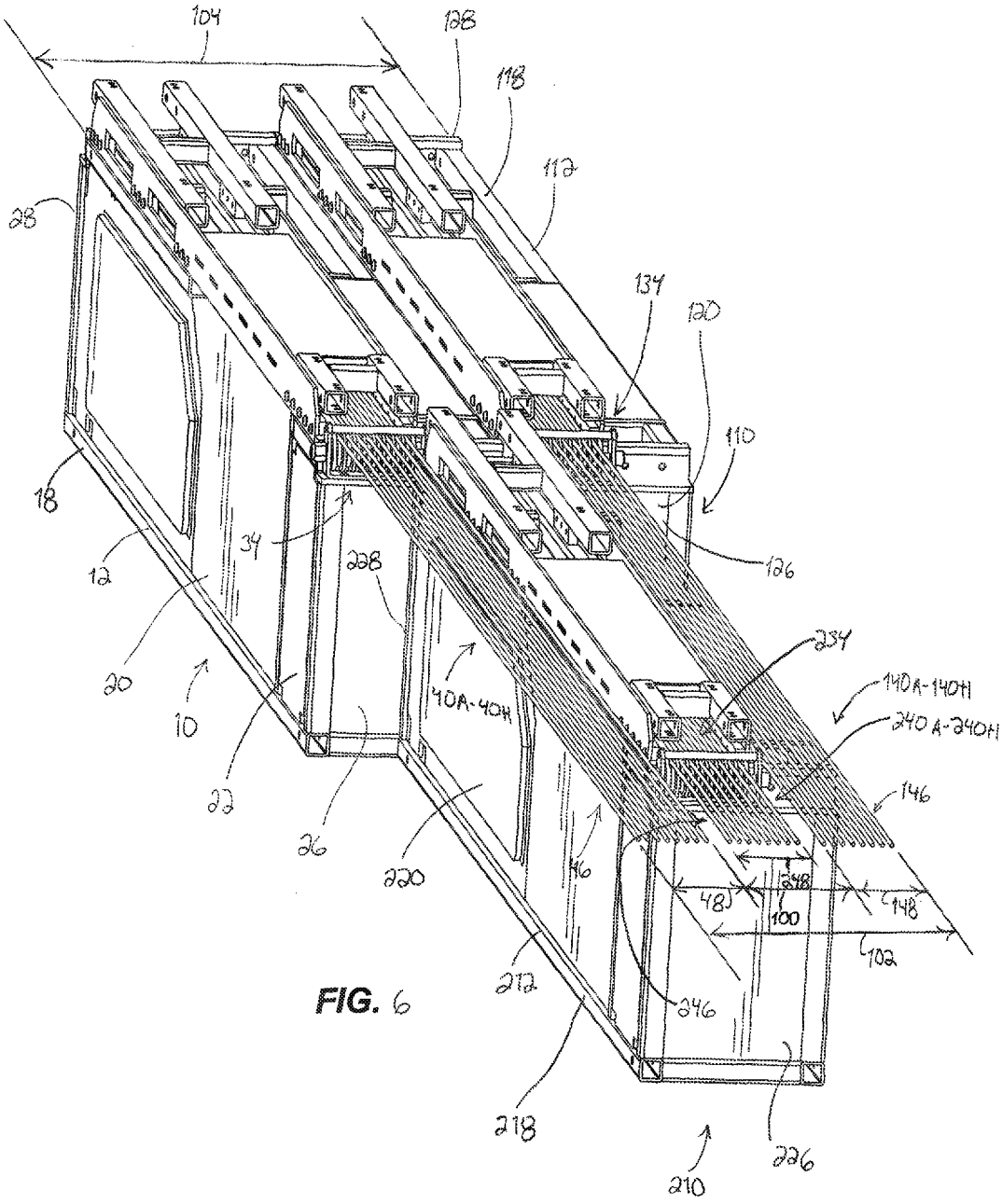
104
128
118
117
28
134
120
110
18
34
228
126
12
234
140A-140H
20
10
240A-240H
146
22
26
220
148
100
102
212
246
218
210
226

FIG. 6

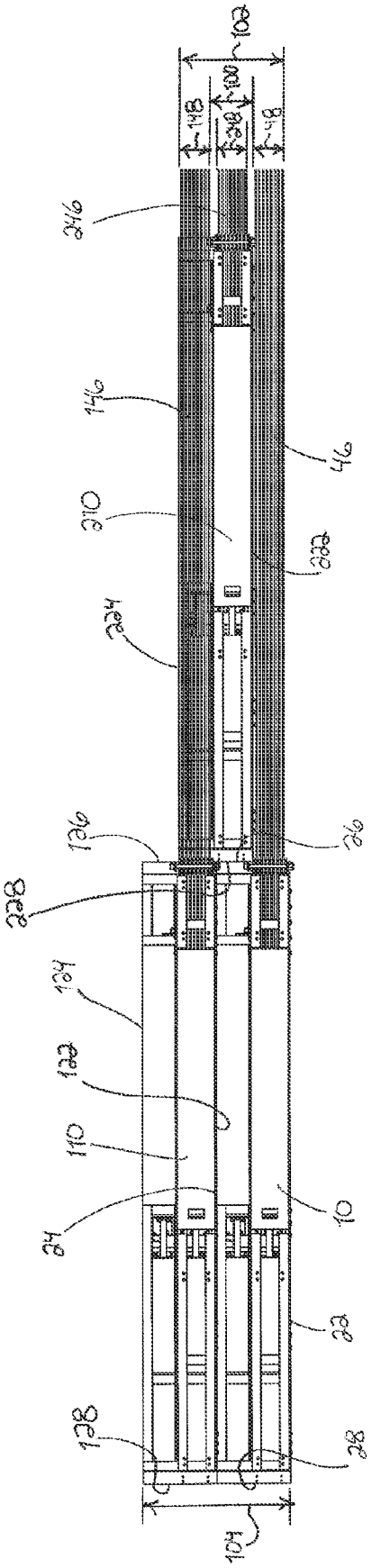
102
148
150
148
246
146
46
210
232
224
136
26
228
124
122
110
24
10
22
128
28
104

FIG. 7

NESTED LIFT ASSEMBLIES

BACKGROUND

The present invention relates generally to lift assemblies, such as those used to raise and lower scenery, props, and lighting on a stage.

SUMMARY

In one embodiment, the invention provides a lift assembly that includes a base having a first side and a second side opposite the first side. The base defines an outlet positioned closer to the first side than to the second side. The lift assembly further includes a take-up mechanism mounted to the base, and a cable having a stored portion on the take-up mechanism and a free portion extending from the take-up mechanism through the outlet.

In another embodiment the invention provides a group of lift assemblies that includes a first lift assembly having a base including a first side and a second side opposite the first side, the base having an end defining an outlet positioned closer to the first side than to the second side, a take-up mechanism mounted to the base, and a cable having a stored portion on the take-up mechanism and a free portion extending from the take-up mechanism through the outlet. The group further includes a second lift assembly including a base having a first side and a second side opposite the first side, the base having an end defining an outlet positioned closer to the first side than to the second side, a take-up mechanism mounted to the base, and a cable having a stored portion on the take-up mechanism and a free portion extending from the take-up mechanism through the outlet. The first side of the first lift assembly is positioned adjacent the second side of the second lift assembly, such that the cable exiting the outlet of the first lift assembly is spaced from the cable exiting the outlet of the second lift assembly. The group further includes a third lift assembly including a base having a first side and a second side opposite the first side, the base having a first end defining an outlet positioned closer to the first side than to the second side, and the base further having a second end opposite the first end, a take-up mechanism mounted to the base, and a cable having a stored portion on the take-up mechanism and a free portion extending from the take-up mechanism through the outlet. The second end of the base of the third lift assembly abuts the ends of the first and second lift assemblies, and the cable exiting the outlet of the third lift assembly is positioned between the cables exiting the first and second lift assemblies.

In another embodiment, the invention provides a group of lift assemblies that includes a first lift assembly including a first base having a longitudinal extent terminating at a first end defining a first outlet, and a first cable exiting through the first outlet. The group further includes a second lift assembly including a second base having a longitudinal extent terminating at a second end defining a second outlet, and a second cable exiting through the second outlet. The first and second bases abut each other along the longitudinal extent with the first and second ends facing in the same direction such that the first and second cables extend from the respective first and second bases in substantially the same direction. The group further includes a third lift assembly including a third base having a longitudinal extent terminating at a third end defining a third outlet, the third base further including a fourth end opposite the third end and abutting at least one of the first and second ends. The first, second, and third cables extend from the group of lift assemblies in substantially the same direction.

Other aspects of the invention will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a lift assembly according to one embodiment of the invention.

FIG. **2** is an alternative perspective view of the lift assembly of FIG. **1** with side panels of the lift assembly removed.

FIG. **3** is a cross-sectional view of a portion of the lift assembly of FIG. **1** taken along lines **3-3** of FIG. **2**.

FIG. **4** is an enlarged view of a portion of FIG. **3**

FIG. **5** illustrates one application of the lift assembly of FIG. **1**.

FIG. **6** is a perspective view of multiple lift assemblies of FIG. **1** in a nested configuration according to another embodiment of the invention.

FIG. **7** is a top view of the nested lift assemblies of FIG. **4**.

DETAILED DESCRIPTION

Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways.

FIGS. **1-2** illustrate a lift assembly **10** including a base **12** and a take-up mechanism **14** that is mounted to the base **12**. The base **12** includes a frame **18** and side panels **20** that are secured to the frame **18**. The frame **18** provides a stable location for mounting the various internal components of the assembly **10**, and the panels **20** provide a barrier for inhibiting contamination of and unauthorized access to the internal components and the panels **20** can also be sound deadening panels.

The base **12** further includes a first side **22**, a second side **24**, a first end **26**, and a second end **28** that are defined by the frame **18** and the panels **20**. The first side **22** and the second side **24** are parallel and face opposite directions and the first end **26** and the second end **28** are parallel and face opposite directions. The first and second sides **22**, **24** extend along the length of the assembly **10** and a longitudinal axis or centerline **30** of the assembly **10** extends midway between the sides **22**, **24** and bisecting the ends **26**, **28**. A length or longitudinal extent of the assembly **10** is the distance from the first end **26** to the second end **28** along the axis **30**.

The base **12** further includes a first outlet **34** and a second outlet **36**, the purpose of which will be discussed in more detail below. The first outlet **34** is located through the first end **26** of the base **12** and is positioned closer to the first side **22** than to the second side **24**. Alternatively stated, the first outlet **34** is offset from the centerline **30** toward the first side **22** of the base **12**. The second outlet **36** is located through the second end **28** of the base **12** and is positioned closer to the first side **22** of the base **12** than the second side **24**. Similar to the first outlet **34**, the second outlet **36** is offset from the centerline **30** toward the first side **22** of the base **12**.

Referring to FIGS. **1** and **3**, the lift assembly **10** further includes flexible drive elements **40**A-**40**H. Each of the flexible drive elements **40**A-**40**H is essentially the same (the only difference being their respective length), and only one flexible drive element **40**A will be described in detail. Like portions of the drive elements **40**A-**40**H have been give the same reference number with the suffix A-H, respectively. The flex-

ible drive element **40**A includes a stored portion **42**A that is on the take-up mechanism **14** and a free portion **44**A that extends from the take-up mechanism **14** through the outlet **34**. The free portion **44**A that extends through the outlet **34** is closer to the first side **22** of the base **12** than to the second side **24**. That is, the free portion **44**A is offset from the centerline **30** of the base **12** is a direction toward the first side **22**. Together the flexible drive elements **40**A-**40**H extend through the outlet **34** to define a cable path **46** having a cable path width **48** (see FIG. **4**). The cable path **46** is offset from the centerline **30** of the base **12** in a direction toward the first side **22**. In the illustrated embodiment, the entire cable path **46** (i.e., all of the flexible drive elements **40**A-**40**H) exiting the outlet **34** is located between the first side **22** and the centerline **30**. In other embodiments, a portion of the cable path **46** can be on the other side of the centerline **30** (i.e., between the centerline **30** and the second side **24**). Also, in the illustrated embodiment, all of the flexible drive elements **40**A-**40**H in the cable path are flush in a direction perpendicular to the cable path **46**, such that the cable path **46** is flat and the flexible drive elements **40**A-**40**H are co-planar. In the illustrated embodiment, the flexible drive elements **40**A-**40** H are cables, such as a twisted wire cables with multiple strands, but in other embodiment, other suitable flexible drive elements may be utilized, such as, chains, ropes, and the like.

As illustrated in FIG. **5**, in one application of the lift assembly **10**, the free portions **44**A-**44**H of the flexible drive elements **40**A-**40**H are routed to loft blocks **86** that change the direction of the flexible drive elements **40**A-**40**H and then routed to a batten **88** or the like to raise and lower an article **90** such as scenery, props, and lighting on a stage.

Referring to FIG. **2**, the take-up mechanism **14** includes a drive mechanism **50** and a drum assembly **52**. The drive mechanism **50** includes an electric motor **54**, a transmission **56**, and a drive shaft **58**. The transmission connects the motor **54** and the drive shaft **58** such that operation of the motor **54** rotates the drive shaft **58** in the clockwise and counterclockwise directions. The drum assembly **52** is coupled to the drive shaft **58**, such that rotation of the drive shaft **58** by the motor **54** rotates the drum assembly **52** in the clockwise and counterclockwise directions. In the illustrated embodiment, the drum **52** and the drive shaft **58** move axially along the longitudinal axis **30** of the base **12**, the purpose of which will discussed in more detail below.

Referring to FIGS. **3** and **4**, the drum assembly **52** includes drum segments **60**A-**60**H. The drum segments **60**A-**60**H correspond to the flexible drive elements **40**A-**40**H. That is, the flexible drive element **40**A winds around drum segment **60**A, the flexible drive element **40**B winds around drum segment **60**B, etc. The drum segments **60**A-**60**H are substantially the same and like components have been given like reference numbers with the suffix A-H, which corresponds to the drum segments **60**A-**60**H. The drum segment **60**A includes a first end **62**A and a second end **64**A. The first end **62**A has a diameter **66**A and the second end **64**A has a diameter **68**A that is larger than the diameter **66**A. The diameter of the drum segment **60**A constantly increases from the first end **62**A to the second end **64**A. Therefore, a large diameter portion **70**A of the drum segment **60**A is located adjacent the second end **64**A, a small diameter portion **72**A is located adjacent the first end **62**A, and a tapered portion **74**A is located between the small diameter portion **72**A and the large diameter portion **70**A.

The drum segments **60**A-**60**H are coupled to the drive shaft **58** as best seen in FIG. **3**. The first end **62**B of the second drum segment **60**B having the small diameter **66**B abuts the second end **64**A of the first drum segment **60**A having the large diameter **68**A. Likewise, the first end **62**C of the third drum segment **60**C having the small diameter **66**B abuts the second end **64**B of the second drum segment **60**B having the large diameter **68**B. The remainder of the drum segments **60**D-**60**H are similarly arranged along the drive shaft **58**.

The drum segments **60**A-**60**H all includes grooves **76**A-**76**H, respectively, that extend circumferentially around the drum segments **60**A-**60**H. The grooves **76**A-**76**H receive the respective flexible drive elements **40**A-**40**H to facilitate winding the flexible drive elements **40**A-**40**H around the drum assembly **52**.

Referring to FIG. **2**, the lift assembly further includes internal sheaves **80**A-**80**H. The internal sheave **80**A corresponds to the drum segment **60**A and the flexible drive element **40**A, the internal sheave **80**B corresponds to the drum segment **60**B and the flexible drive element **40**B, etc. The sheaves **80**A-**80**H direct the corresponding flexible drive element **40**A-**40**H from the corresponding drum segment **60**A-**60**H to the outlet **34**. A head block **82** is located adjacent the outlet **34**. The head block **82** includes a plurality of rollers **84** that guide the flexible drive elements **40**A-**40**H. In the illustrated embodiment, the internal sheaves **80**A-**80**H can be configured to route the flexible drive elements **80**A-**80**H through the first outlet **34** and the second outlet **36**. When any of the flexible drive elements **80**A-**80**H are routed through the second outlet **36** a second head block, similar to head block **82**, would be located adjacent the second outlet **36**.

With continued reference to FIG. **2**, the illustrated lift assembly **10** includes a threaded rod **92** located at an end of the shaft **58**. The rod **92** is fixed relative to the frame **18**. The shaft **58** is generally hollow and the threaded rob **92** is received in a threaded recess of the shaft **58**. As the shaft **58** rotates relative to the rod **92** (which is fixed relative to the frame **18**) the shaft **58** and drum assembly **52** (which is fixed relative to the shaft **58**) move relative to the internal sheaves **80**A-**80**H along the longitudinal axis **30** to facilitate winding and unwinding the flexible drive elements **40**A-**40**H around the drum assembly **52**.

In operation, the motor **54** rotates the drive shaft **58** to wind and unwind the flexible drive elements **40**A-**40**H around the drum assembly **52** to raise and lower the free portions **44**A-**44**H of the flexible drive elements **40**A-**40**H, which raises and lowers an article, such as scenery, props, lighting, and the like that are attached to the free portions **44**A-**44**H. As best seen in FIG. **3**, when raising the article, the flexible drive elements **40**A-**40**H wrap around the corresponding drum segment **60**A-**60**H in the corresponding grooves **76**A-**76**H. The first flexible drive element **40**A starts wrapping around the segment **60**A in the grooves **76**A in the small diameter portion **72**A of the segment **60**A. Meanwhile, the second flexible drive element **40**B starts wrapping around the drum segment **60**B in the grooves **76**B in the small diameter portion **72**B of the drum segment **60**B. The additional flexible drive elements **40**C-**40**H likewise wrap around the corresponding drum segments **60**C-**60**H.

The flexible drive element **40**B is wrapped onto the small diameter portion **72**B of the drum segment **60**B to define an outer profile or outer diameter that is substantially flush with the large diameter portion **70**A of the drum segment **60**A. As the flexible drive element **40**A continues to wind onto the drum segment **60**A, the additional stored portion **42**A moves in a direction toward the drum segment **60**B because the drum assembly **52** moves relative to the frame **18** along the longitudinal axis **30**. Eventually, the flexible drive element **40**A wraps around the drum segment **60**A until it reaches the second end **64**A of the drum segment **60**A, and as the flexible drive element **40**A continues to wind around the drum assem-

bly **52**, the flexible drive element **40**A overlaps onto the outer profile created by the flexible drive element **40**B. As discussed above, the outer profile of the drive element **40**B is flush with the second end **64**A of the drum segment **60**A, and therefore the drive element **40**A smoothly transitions from wrapping around the segment **60**A and onto the segment **60**B. As illustrated in FIG. **3**, the other flexible drive elements **40**B-**40**G similarly overlap onto the adjacent drum segment **60**B-**60**G. Because segment **60**H is the final drum segment there is no adjacent segment for drive element **40**H to wrap onto and around. Therefore, drum segment **60**H is longer and has a longer tapered portion **74**H than the other drum segments **60**A-**60**G.

As illustrated in FIGS. **6** and **7**, multiple lift assemblies **10**, **110**, and **210** can be mounted adjacent to each other and together the lift assemblies **10**, **110**, **210** can be mounted to a structure, such as a ceiling, a floor, walls, or other suitably stable component. Each of the illustrated lift assemblies **10**, **110**, and **210** is structurally identical to the other lift assemblies **10**, **110**, and **210** and identical to the lift assembly **10** described above with regard to FIGS. **1-3** and therefore like components have been given like reference numbers plus 100. Each has lift assembly **10**, **110**, and **210** has its own position or orientation, as described below in more detail.

With continued reference to FIGS. **6** and **7**, the second side **24** of the first lift assembly **10** is positioned adjacent the first side **122** of the second lift assembly **110**. In the illustrated embodiment, the second side **24** of the lift assembly **10** abuts the first side **122** of the lift assembly **110**. Also, the ends **26**, **126** and **28**, **128** are aligned and flush as illustrated. Therefore, the cable path **46** and the cable path **146** extend in the same direction and are parallel. As illustrated in FIGS. **6** and **7**, the cable path **46** exiting the base **12** of the first lift assembly **10** is spaced a distance **100** from the cable path **146** exiting the base **112** of the second lift assembly **110**.

The second end **228** of the base **212** of the third lift assembly **210** abuts the first end **26** of the first lift assembly **10** and the first end **126** of the second lift assembly **110** to define a pyramid arrangement with the third lift assembly **210** forming a peak of the pyramid. The third lift assembly **210** is positioned so that the cable path **246** is between in the cable paths **46**, **146** and located in the space **100**. The cable path **246** extends in the same direction as the cable paths **46**, **146** and parallel to the paths **46**, **146** and the cable paths **46**, **146**, **246** are co-planar. Together the cable paths **46**, **146**, **246** define a total cable path width **102**. In the illustrated embodiment that includes three lift assemblies **10**, **110**, **210**, the total cable path width **102** is only about 3.6 times greater than the width **48** of a single cable path **48**, **148**, **248**. In other embodiments, the total cable path width is between about 3.3 to 3.9 times greater than the width of a single cable path. In yet other embodiments, the total cable path width is between about 3.1 to 4.1 times greater than the width of a single cable path.

The base **12** of the first lift assembly **10** and the base **112** of the second lift assembly **110** are side-by-side to define a total width **104** (FIG. **7**) of the group of lift assemblies **10**, **110**, and **210**. The total cable path width **102** is less than the width **104** of the group of lift assemblies **10**, **110**, **210**. In some embodiments, the total cable path width **102** is less than 80 percent of the width **104**, and in yet other embodiment, the total cable path width **102** is less than 95 percent of the width **104**

The first, second, and third lift assemblies **10**, **110**, **210** can be coupled using any suitable fastener or method such as bolts, welding, and the like. Also, although the illustrated third lift assembly **210** abuts both ends **26**, **126** of the lift assemblies **10**, **110**, respectively, in other embodiments, the end **226** of the third lift assembly **210** may abut only one of the ends **26**, **126**.

The nested arrangement of the lift assemblies **10**, **110**, **210**, described above, reduces the total cable path width **102** (compared to positioning the three lift assemblies In a side-by-side orientation). Reducing the total cable path width **102** is desirable because it reduces the distance required between articles lifted by the lift assemblies **10**, **110**, **210**. Or, if the lift assemblies **10**, **110**, **210** are lifting the same article, the distance between all the flexible drive elements **40**, **140**, **240** is reduced, which reduces the horizontal spacing required between any loft blocks that redirect the flexible drive elements **40**, **140**, **240** down to the article being raised and lowered.

Various features and advantages of the invention are set forth in the following claims.

What is claimed is:

1. A group of lift assemblies comprising:

a first lift assembly including:

a base having a first side and a second side opposite the first side, the base having an end defining an outlet positioned closer to the first side than to the second side;

a take-up mechanism mounted to the base;

a cable having a stored portion on the take-up mechanism and a free portion extending from the take-up mechanism through the outlet;

a second lift assembly including:

a base having a first side and a second side opposite the first side, the base having an end defining an outlet positioned closer to the first side than to the second side;

a take-up mechanism mounted to the base;

a cable having a stored portion on the take-up mechanism and a free portion extending from the take-up mechanism through the outlet,

wherein the first side of the first lift assembly is positioned adjacent the second side of the second lift assembly, such that the cable exiting the outlet of the first lift assembly is spaced from the cable exiting the outlet of the second lift assembly; and

a third lift assembly including:

a base having a first side and a second side opposite the first side, the base having a first end defining an outlet positioned closer to the first side than to the second side, and the base further having a second end opposite the first end;

a take-up mechanism mounted to the base;

a cable having a stored portion on the take-up mechanism and a free portion extending from the take-up mechanism through the outlet,

wherein the second end of the base of the third lift assembly abuts the ends of the first and second lift assemblies, and wherein the cable exiting the outlet of the third lift assembly is positioned between the cables exiting the first and second lift assemblies.

2. The group of lift assemblies of claim **1**, wherein the first, second, and third lift assemblies are arranged in a pyramid arrangement.

3. The group of lift assemblies of claim **2**, wherein the third lift assembly forms a peak of the pyramid.

4. The group of lift assemblies of claim **1**, wherein the free portions of the first, second, and third lift assemblies have sections that are substantially co-planar.

5. The group of lift assemblies of claim **1**, wherein the bases of the first and second lift assemblies are side-by-side

and define a group width, and wherein a total width of cables exiting the first, second, and third lift assemblies is less than the group width.

6. The group of lift assemblies of claim **5**, wherein the total width of cables exiting the first, second, and third lift assemblies is less than 95 percent of the group width.

7. A group of lift assemblies comprising:

a first lift assembly including:

a first base having a longitudinal extent terminating at a first end defining a first outlet;

a first cable exiting through the first outlet;

a second lift assembly including:

a second base having a longitudinal extent terminating at a second end defining a second outlet;

a second cable exiting through the second outlet,

wherein the first and second bases abut each other along the longitudinal extent with the first and second ends facing in the same direction such that the first and second cables extend from the respective first and second bases in substantially the same direction; and

a third lift assembly including:

a third base having a longitudinal extent terminating at a third end defining a third outlet, the third base further including a fourth end opposite the third end and abutting at least one of the first and second ends,

wherein the first, second, and third cables extend from the group of lift assemblies in substantially the same direction, and

wherein the fourth end abuts both of the first and second ends.

8. The group of lift assemblies of claim **7**, wherein the third cable exiting the third outlet is positioned substantially between the first and second cables exiting the first and second outlets, respectively.

9. The group of lift assemblies of claim **7**, wherein the first, second, and third cables exiting the first, second, and third outlets, respectively are substantially co-planar.

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