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UNITED STATES DISTRICT COURT

CENTRAL DISTRICT OF CALIFORNIA

RSA PROTECTIVE TECHNOLOGIES, LLC,
Plaintiff,
v.

DELTA SCIENTIFIC CORPORATION,
Defendant.

No. 19-6024

COMPLAINT FOR INFRINGEMENT OF U.S. PATENT NO. 8,215,865; DEMAND FOR JURY TRIAL

Complaint Filed: 7/12/2019
Trial Date: To be set

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Attorneys for Plaintiff RSA Protective Technologies, LLC

Plaintiff RSA Protective Technologies LLC ("Plaintiff"), by and through its attorneys, alleges as follows for its Complaint against Defendant Delta Scientific Corporation ("Delta Scientific"):

NATURE OF THE CLAIMS

1. This is an action for patent infringement of Plaintiff's U.S. Patent No. 8,215,865 ("the '865 patent" or "the Asserted Patent"). The '865 patent is directed to an anti-ram system and method of constructing shallow mount bollards. Defendant infringes the Asserted Patent by importing, making, using, offering, and/or selling infringing shallow mount bollards that infringe the '865 patent.

THE PARTIES

RSA Protective Technologies

2. Plaintiff is a limited liability corporation organized and existing under the laws of Delaware, having its principal place of business at 223 Independence Drive, Claremont, CA 91711.

3. Plaintiff develops and implements large scale civil infrastructure inventions with a focus on public safety. RSA Protective Technologies has been in business for over seventeen years.

4. Plaintiff designs and manufactures shallow mount security bollards and routinely bids on and provides shallow mount bollards for projects around the world.

5. Plaintiff owns the Asserted Patent.

Delta Scientific Corporation

6. Upon information and belief, Delta Scientific is a domestic stock entity organized and existing under the laws of the state of California with its principal place of business at 40355 Delta Lane, Palmdale, California 93551.

7. Upon information and belief, Delta Scientific sells shallow mount security bollards that it manufactures at its 260,000 square foot manufacturing space in Palmdale, CA. Delta Scientific also offers installation service and technical oversight of said manufactured bollards.

8. Upon information and belief, counter-terrorist barricade systems, including shallow mount security bollards, manufactured by Delta Scientific have been sold to, and installed by, domestic and international customers, including but not limited to the U.S. Federal Government, U.S. Navy Air Force, police departments, U.S. and foreign embassies, private companies and private residences. High profile installations of Delta Scientific's counter-terrorist barricade systems include the U.S. Department of State, U.S. Capitol, Reagan Presidential Library, Singapore Parliament, LAX Airport, Pear Harbor Navy Piers, and Buckingham Palace.

JURISDICTION AND VENUE

9. This action arises under the patent laws of the United States, 35 U.S.C. § 1 *et seq.*, including 35 U.S.C. § 271. This Court has subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a).

10. This Court has personal jurisdiction over Delta Scientific because it is organized under the laws of California and has a principal place of business in Palmdale, California. This Court also has personal jurisdiction over Delta Scientific because it directly infringed the Asserted Patent by making, using, selling, offering to sell and/or importing infringing products in the Central District of California.

11. Venue is proper in this district pursuant to 28 U.S.C. §§ 1391(b), 1391(c), 1391(d), and/or 1400(b) with respect to Delta Scientific because Defendant is organized under the laws of California, has regular and established places of business in this

district, and committed acts of infringement in this district.

FACTUAL BACKGROUND

Asserted Patent

12. On July 10, 2012, the United States Patent and Trademark Office ("USPTO") duly and legally issued the '865 patent, entitled "Anti-Ram System and Method of Installation." A copy of the '865 patent is attached as Exhibit A.

13. The application leading to the '865 patent published, and was available to the public, on July 1, 2010, as Publication No. US 2010/0166498 A1.

14. Plaintiff owns all right, title, and interest in the '865 patent, including the right to use and enforce the '865 patent.

15. The '865 patent claims an anti-ram system and method of constructing shallow mount bollards.

16. Upon information and belief, Delta Scientific represented to the Department of State that it was deliberately attempting to copy Plaintiff's patented technology.

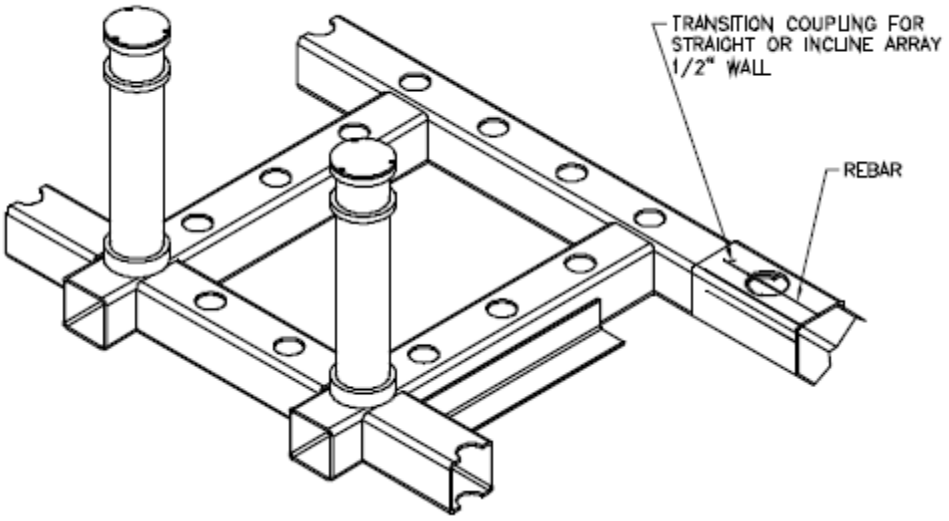
17. Upon information and belief, Defendant had knowledge of the '865 patent as RSA provided constructive notice of the '865 patent to Defendant by marking its shallow mount bollard products with the '865 patent number.

18. RSA Protective Technologies was, and continues to be, the owner of the '865 patent.

The Delta Scientific Accused Products

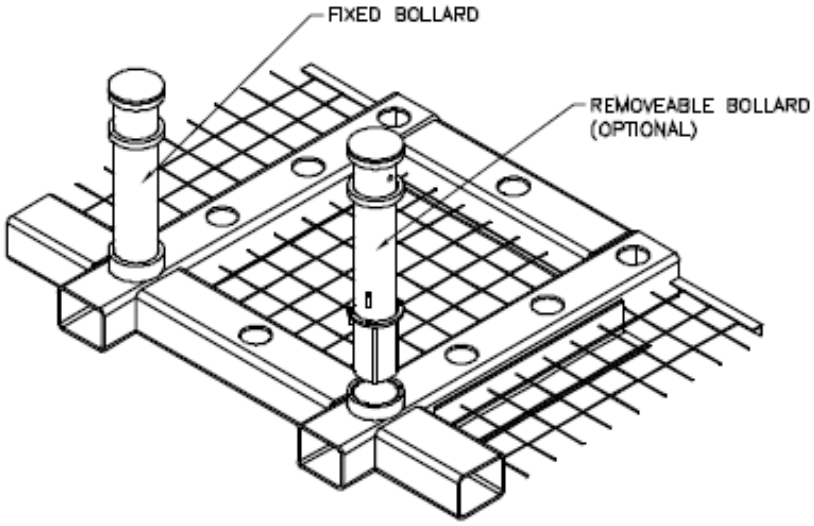
19. Delta Scientific designs, manufactures, uses, sells, and offers to sell shallow mount bollards with, at least, the following structures:

Delta Scientific Model No.: **DSC600**



(Excerpt from Exhibit B)

Delta Scientific Model No.: **DSC650**



(Excerpt from Exhibit C)

20. On information and belief, at least the Delta Scientific shallow mount bollards with model numbers DSC600 (depicted and described in Exhibit B, D) and DSC650 (depicted and described in Exhibit C, E) infringe the '865 patent.

21. On information and belief, Delta Scientific designs, engineers, and

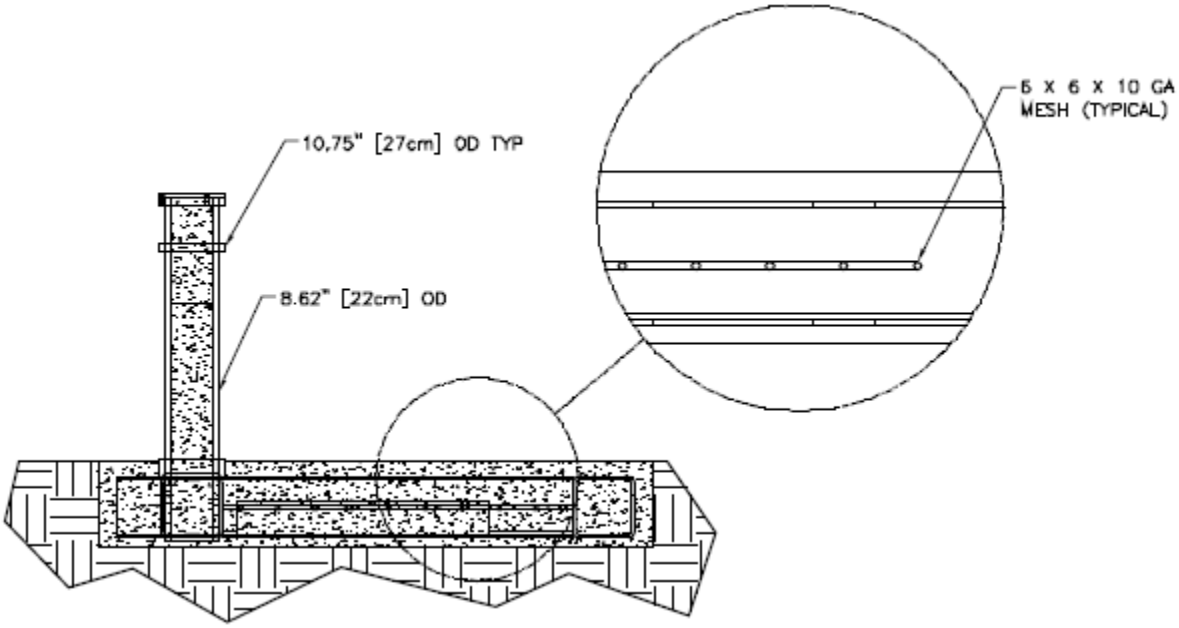
manufactures shallow mount bollards, either directly or through intermediaries (including distributors, retailers, and others), ships, distributes, offers for sale, sells, and advertises the infringing bollards abroad, in the United States, in the State of California, and in this district.

Infringement of the '865 Patent by Delta Scientific's Shallow Mount Bollards

22. The shallow mount bollards designed, manufactured, sold, used, and offered for sale by Delta Scientific, including but not limited to those with model numbers DSC600 and DSC650, infringe the claims of the '865 patent. *See* Exhibits B, C, D, E.

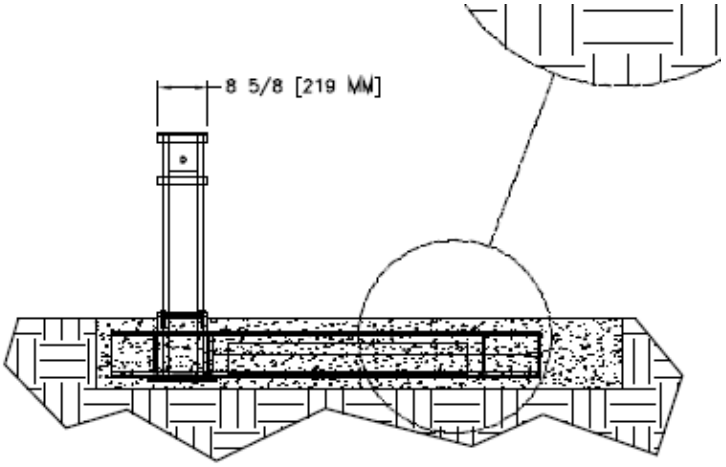
23. The Delta Scientific shallow mount bollards meet all of the limitation in claim 1 of the '865 patent because, for example:

24. Upon information and belief, the Delta Scientific DSC600 shallow mount bollard has a base with opposed ends as shown in the following drawing:



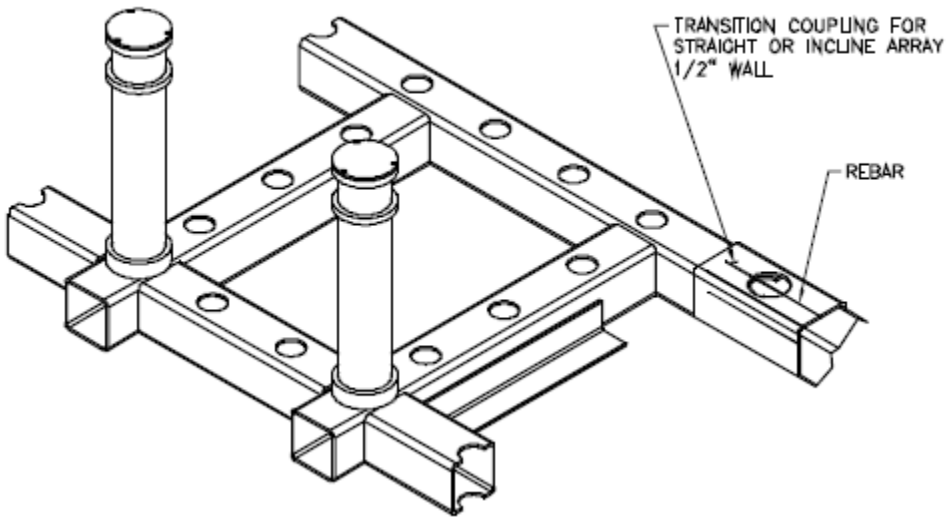
(Excerpt from Exhibit B)

25. Upon information and belief, the Delta Scientific DSC650 shallow mount bollard has a base with opposed ends as shown in the following drawing:

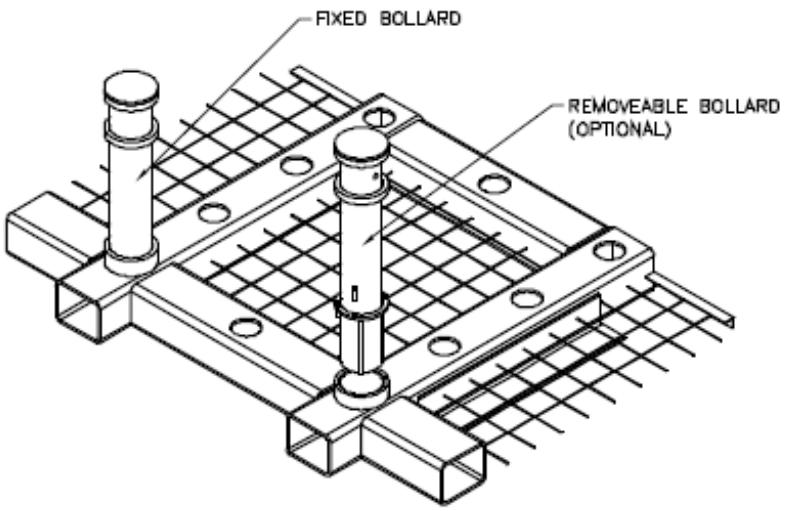


(Excerpt from Exhibit C)

26. Upon information and belief, the Delta Scientific DSC600 and DSC650 shallow mount bollards have "a plurality of structural members," which include the steel members shown below, or the equivalent thereof. Upon further information and belief, these structural members intersect with each other and are tied together, or the equivalent thereof:

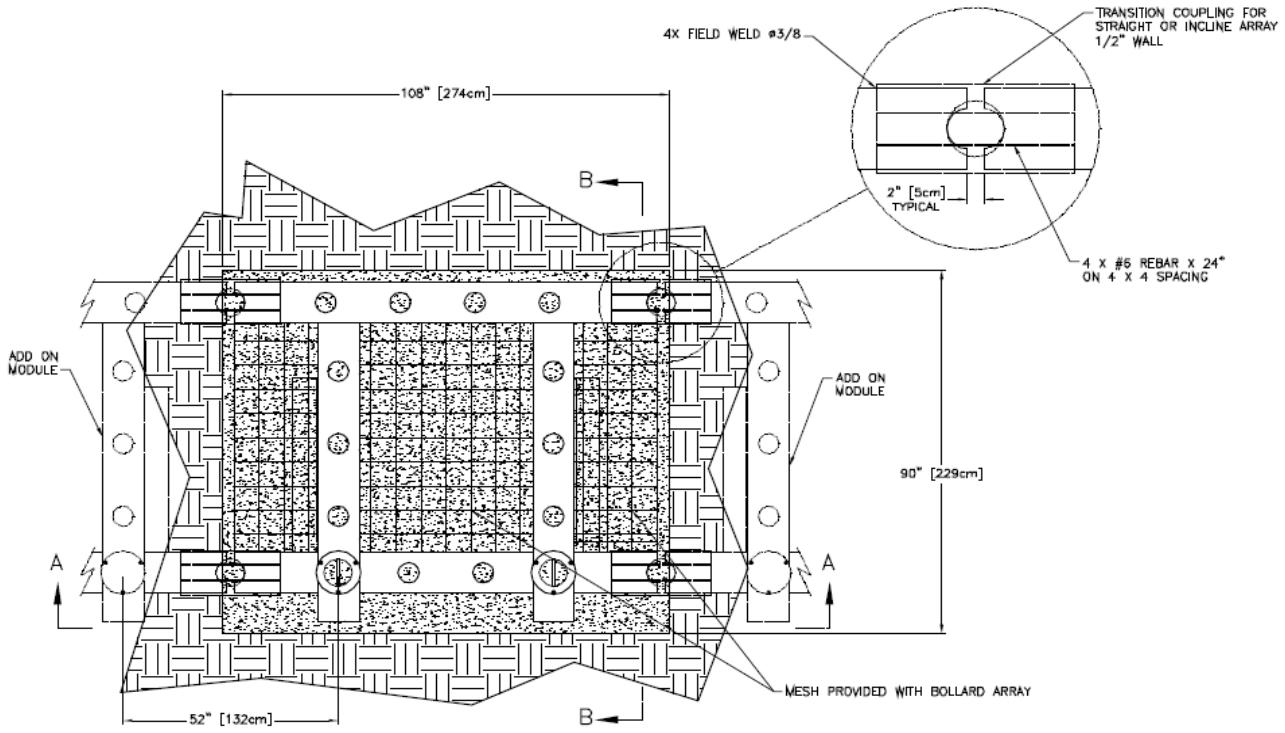


(Excerpt from Exhibit B)

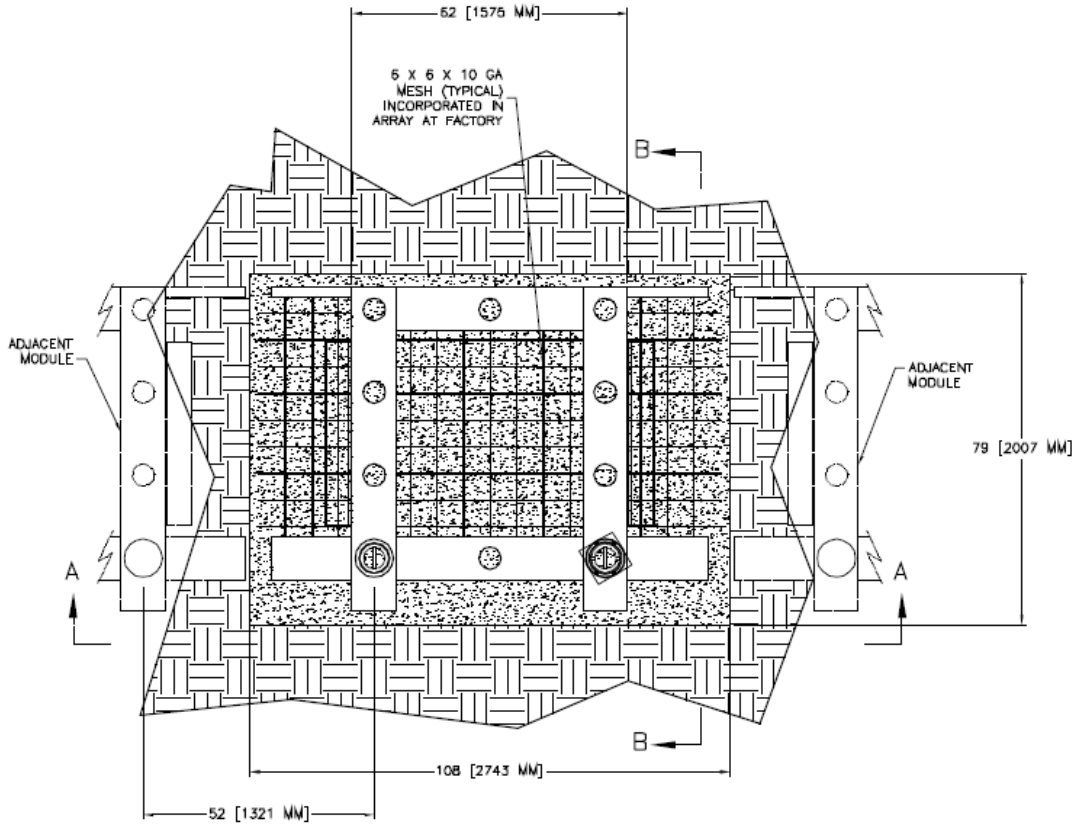


(Excerpt from Exhibit C)

27. Upon information and belief, for each bollard of the shallow bollard structure, at least one first structural member extends from a first of the opposed ends of the base to a second of the opposed ends of the base in a first direction intersection with the opposed ends and at least one structural members extends to intersect with the at least one first structural member, or the equivalent thereof. Upon information and belief, there are structural members that extend from a first of the opposed ends to a second of the opposed ends, as well as structural members that extend between the other two opposed ends, or the equivalent thereof. These two sets of structural members intersect with one another.

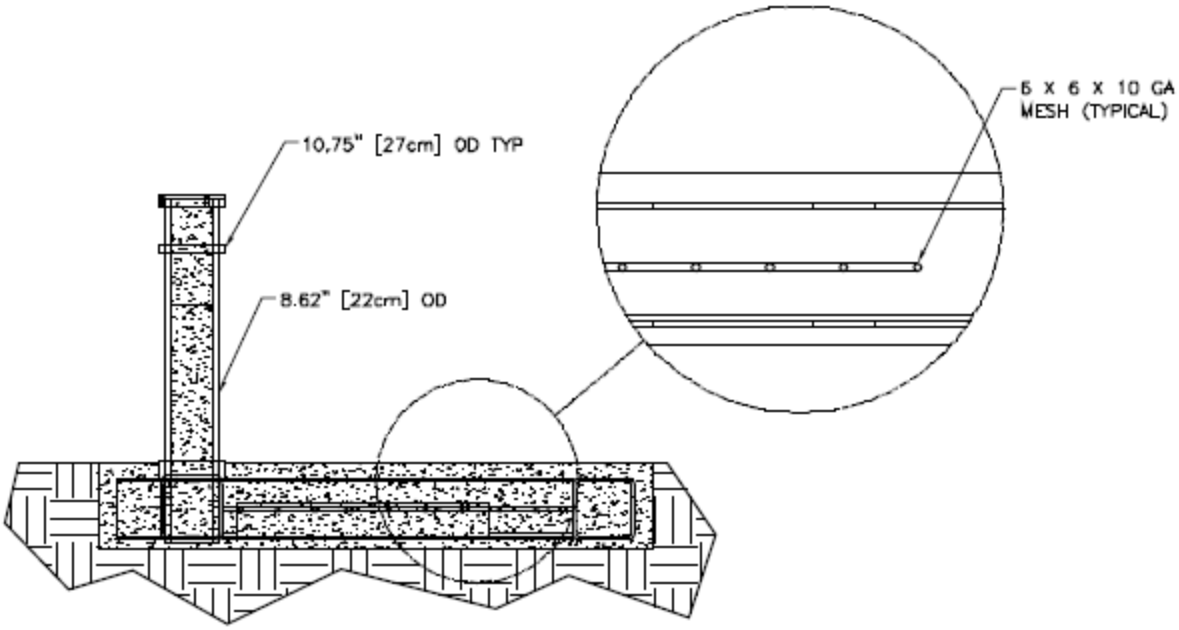


(Excerpt from Exhibit B)

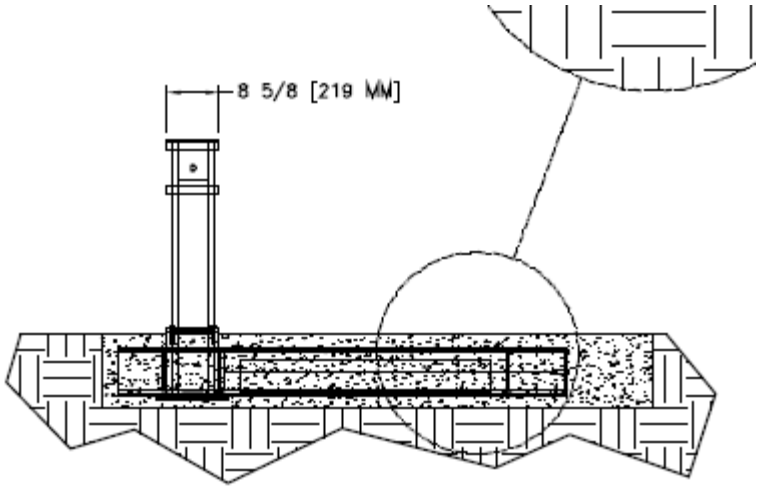


(Excerpt from Exhibit C)

28. Upon information and belief, the Delta Scientific shallow mount bollards are secured to structural members, shown below, and extends upwardly from the base so as to transmit forces applied to the at least one bollard to the base, or the equivalent thereof.



(Excerpt from Exhibit B)



(Excerpt from Exhibit C)

29. Upon information and belief, the base of the Delta Scientific shallow mount bollards have been configured to be mounted in a shallow excavation with at least one bollard extending above grade, or the equivalent thereof. The "DSC600" bollard is a "K-12" model named "shallow foundation bollard" and that the "DSC650" bollard is a "removable" version of the DSC600 shallow foundation bollard. The DSC600 model has a foundation of only 14 inches and the DSC650 bollard has a foundation of 12 inches deep. *See* Exhibits D, E.

30. Upon information and belief, the Delta Scientific shallow mount bollards also have structural members that are configured or tied together to retain within the base supporting media introduced into the base when the base is mounted. The structural members allow for supporting media to be poured into the base and allow the bollard to be supported by media and resist rotation, or the equivalent thereof.

31. The Delta Scientific shallow mount bollards also infringe dependent claim 2 of the '865 patent, which recites "[t]he bollard structure of claim 1, wherein at least one of the opposed ends is formed by a structural member to which an end of the at least one first structural member is secured." On information and belief, the structural members are secured to one another where they intersect (as seen in the exhibit excerpts featured in paragraph 26), or the equivalent thereof.

32. The Delta Scientific shallow mount bollards infringe dependent claim 3 of the '865 patent, which recites "[t]he bollard structure of claim 1, wherein the intersecting structural members have axes that extend parallel to a plane of the base." On information and belief, the structural members appear to run parallel to the plane of the base and are equidistant from the base at all points along their length, or the equivalent thereof. The Delta Scientific shallow mount bollards also infringe dependent

claim 4 of the '865 patent, which recites "[t]he bollard structure of claim 1, wherein the base has a height of 3 inches to 14 inches." Upon information and belief, the specification drawing of at least the DSC600 and DSC650 products, contained in Exhibits D and E, feature base height measurements of 3 to 14 inches, or the equivalent thereof.

33. The Delta Scientific shallow mount bollards also infringe dependent claim 5 of the '865 patent, which recites "[t]he bollard structure of claim 1, wherein the plurality of structural members comprise one or more tubular member." Upon information and belief, at least some of the structural members depicted above appear to be tubular, or the equivalent thereof.

34. The Delta Scientific shallow mount bollards also infringe dependent claim 6 of the '865 patent, which recites "[t]he bollard structure of claim 5, wherein at least one tubular member comprises a pipe." Upon information and belief, at least some of the tubular members depicted above appear to be pipe, or the equivalent thereof.

35. The Delta Scientific shallow mount bollards also infringe dependent claim 7 of the '865 patent, which recites "[t]he bollard structure of claim 5, wherein at least one tubular member comprises a tube" because, upon information and belief, the structural members in the images above are long and appear to be hollow, or the equivalent thereof.

36. The Delta Scientific shallow mount bollards also infringe dependent claim 8 of the '865 patent, which recites "[t]he bollard structure of claim 5, wherein at least one tubular member comprises an comprises an angle." Upon information and belief, at least some of the tubular members appear to be made of two perpendicular pieces, or the equivalent thereof.

37. The Delta Scientific shallow mount bollards also infringe dependent claim 9 of the ’865 patent, which recites “[t]he bollard structure of claim 5, wherein at least one tubular member comprises a channel,” because, on information or belief, the tubular members appears to be shaped like a channel, or the equivalent thereof.

38. The Delta Scientific shallow mount bollards also infringe dependent claim 10 of the ’865 patent, which recites “[t]he bollard structure of claim 1, wherein the plurality of structural members comprises at least one tube” because, on information or belief, at least one of the structural members appears to be a tube, or the equivalent thereof.

39. The Delta Scientific shallow mount bollards also infringe dependent claim 11 of the ’865 patent, which recites “[t]he bollard structure of claim 1, wherein the plurality of structural members comprises at least one pipe” because, on information or belief, at least one of the structural members appears to be a pipe, or the equivalent thereof.

40. The Delta Scientific shallow mount bollards also infringe dependent claim 12 of the ’865 patent, which recites “[t]he bollard structure of claim 1, wherein the plurality of structural members comprises at least one angle” because, upon information and belief, at least one structural member appears to be made of two perpendicular pieces, or the equivalent thereof.

41. The Delta Scientific shallow mount bollards also infringe dependent claim 13 of the ’865 patent, which recites “[t]he bollard structure of claim 1, wherein the plurality of structural members comprises at least one channel” because, upon information and belief, at least one structural member appears to be shaped like a channel, or the equivalent thereof.

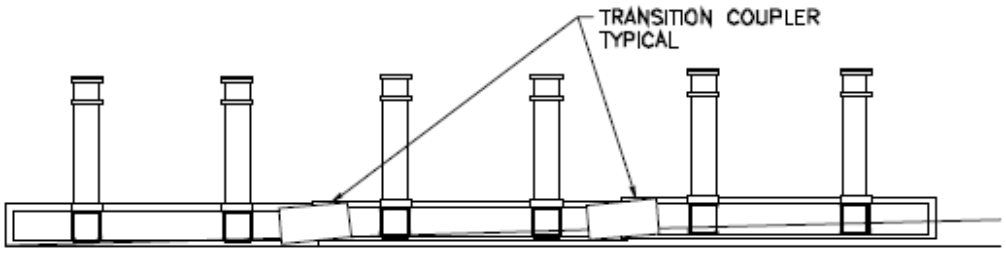
42. The Delta Scientific shallow mount bollards also infringe dependent claim 14 of the ’865 patent, which recites “[t]he bollard structure of claim 1, wherein the plurality of structural members comprises at least one plate” because, upon information and belief, at least one structural member appears to be a flat structure shaped like a plate, or the equivalent thereof.

43. The Delta Scientific shallow mount bollards also infringe dependent claim 15 of the ’865 patent, which recites “[t] bollard structure of claim 1, wherein the plurality of structural members comprise structural steel members” because, upon information and belief, the structural members are made of steel, or the equivalent thereof.

44. The Delta Scientific shallow mount bollards also infringe independent claim 16 of the ’865 patent, which states:

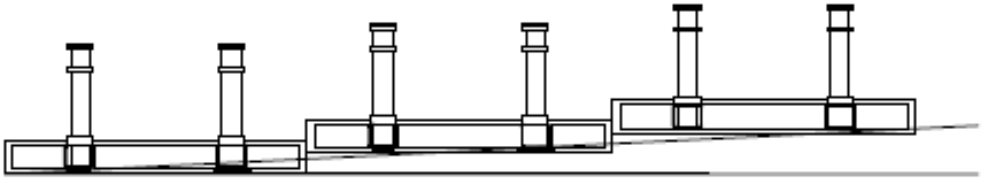
> **16**. A bollard structure comprising:
> a plurality of bollards; and
> a base comprising opposed ends and a plurality of structural members which intersect and are tied together, for each bollard of the bollard structure at least one first structural member extending from a first of the opposed ends of the base to a second of the opposed ends of the base in a first direction intersecting with the opposed ends, and at least one structural member extending to intersect with the at least one first structural member;
> each of the plurality of bollards being secured to at least one of the at least one first structural member and the at least one structural member of the base for the respective bollard and extending upwardly from the base so as to transmit forces applied to the at least one bollard to the base;
> wherein the base is configured to be mounted in a shallow excavation with the plurality of bollards extending above grade of the excavation; and
> wherein the at least one first structural member or the at least one structural member or both are configured or tied together to retain within the base supporting media introduced into the base when the base is mounted in the excavation such that the rotation is resisted of a bollard or bollards and the base from an impact against the bollard or bollards.

45. Upon information and belief, the below photographs demonstrates a bollard structure that is a plurality of bollards lined up in a row. The Delta Scientific shallow mount bollards infringe independent claim 16 for this reason along with those reasons set forth in paragraphs 22-30 above.



INCLINE ARRAY

(Excerpt from Exhibit B)



INCLINE ARRAY

(Excerpt from Exhibit C)

46. The Delta Scientific shallow mount bollards infringe dependent claims 17, 19-31 for the same reasons set forth in paragraphs 31-44 above.

47. The Delta Scientific shallow mount bollards infringe dependent claim 18, which recites "[t]he bollard structure of claim 16, wherein the bollard structure is configured to resist impact from a direction of expected impact and the first direction is parallel to the direction of expected impact, and wherein each of the plurality of bollards is secured to at least one structural member that extends in the first direction." Upon information and belief, Delta Scientific's shallow mount bollards, depicted and described in Exhibits B-E, show that the bollard is configured to resist impact from a vehicle and that the first direction is parallel to the direction of expected impact, and that each bollard is secured to at least one structural member extending in such first

direction, or the equivalent thereof.

48. The Delta Scientific shallow mount bollards infringe dependent claim 32, which recites "[t]he bollard structure of claim 16, comprising a rebar grillage comprising intersecting and tied together rebar members extending coextensively with at least a portion of the base that includes a structural member to which a bollard is secured." Upon information and belief, the Delta Scientific bollard structures are connected by rebar members that intersect and are tied together and extends with the part of the base that includes the member to which the bollard is secured, or the equivalent thereof. The specification drawing in paragraph 27 identifies this rebar, which extends along the portion of the base to which a bollard is secured. This rebar grillage can also be seen in the second drawings in both paragraphs 19 and 26.

49. The Delta Scientific shallow mount bollards also infringe independent claim 33 of the '865 patent, which states:

> **33**. A bollard structure comprising:
> a plurality of bollards; and
> a base comprising opposed ends and a plurality of members which intersect and are tied together, for each bollard of the bollard structure at least one first structural member extending from a first of the opposed ends of the base to a second of the opposed ends of the base in a first direction intersecting with the opposed ends, and at least one structural member extending to intersect with the at least one first structural member;
> each of the plurality of bollards being secured to at least one of the at least one first structural member and the at least one structural member of the base for the respective bollard and extending upwardly from the base so as to transmit forces applied to the at least one bollard to the base;
> at least one of the plurality of members that extend parallel to the ends of the base extending between a structural member to which a first bollard is secured and a structural member to which a second bollard adjacent to the first bollard is secured;
> wherein the base is configured to be mounted in a shallow excavation with the plurality of bollards extending above grade of the excavation; and
> wherein the at least one first structural member or the at least one structural member or both are configured or tied together to retain within the base supporting media introduced into the base when the base is mounted in the excavation such that the rotation is resisted of a bollard or bollards and the base from an impact against the bollard or bollards.

50. Upon information and belief, the Delta Scientific shallow mount bollard structures use members that extend parallel to the ends of the base and connect the structural members to which a first bollard is secured and a structural member to which a second adjacent bollard is secured, or the equivalent thereof. The Delta Scientific shallow mount bollard structures infringe independent claim 33 for this reason along with those reasons set forth in paragraphs 23-30 and 45 above.

51. The Delta Scientific shallow mount bollards infringe dependent claim 34 of the '865 patent, which recites "[t]he bollard structure according to claim 33, wherein the at least one of the plurality of members that extend between a structural member to which a first bollard is secured and a structural member to which a second bollard adjacent to the first bollard is secured comprises a structural member" because, upon information and belief, the plurality of members connecting the bollards are structural members, or an equivalent thereof.

52. The Delta Scientific shallow mount bollards infringe dependent claim 35 of the '865 patent, which recites "[t] bollard structure according to claim 33**,** wherein the at least one of the plurality of members that extend between a structural member to which a first bollard is secured and a structural member to which a second bollard adjacent to the first bollard is secured comprises a rebar member" because, upon information and belief, the plurality of members connecting the bollards are rebar, or an equivalent thereof.

CLAIM FOR RELIEF: DIRECT INFRINGEMENT OF THE '865 PATENT

53. Plaintiff restates and realleges the foregoing allegations as if fully stated herein.

54. Delta Scientific has been and are directly infringing, both literally and/or under the doctrine of equivalents, the claims of the '865 patent in violation of 35 U.S.C. § 271(a), by making, using, importing, selling, and/or offering for sale in or into the United States shallow mount bollards.

55. Delta Scientific has never been licensed, either expressly or impliedly, under the '865 patent.

56. The ’865 patent is valid and enforceable.

57. Plaintiff has complied with the requirements of 35 U.S.C. § 287 by providing actual or constructive notice to Defendant of its alleged infringement.

58. Plaintiff has been, and continues to be, damaged and irreparably harmed by Defendant’s infringement, which will continue unless this Court enjoins this infringement.

59. Plaintiff, under 35 U.S.C. § 284, may recover damages adequate to compensate for Defendant’s infringement in an amount not presently known.

60. Defendant’s infringement of the ’865 patent has been, and continues to be, deliberate, willful, and knowing.

61. The Court should declare this an exceptional case under 35 U.S.C. § 285, entitling Plaintiff to recover treble damages and attorney’s fees.

PRAYER FOR RELIEF

Plaintiff prays for judgment in its favor and against Defendant as follows:

a) That Delta Scientific has infringed one or more claims of the ’865 patent;

b) That Delta Scientific’s infringement is willful, and that this case be deemed exceptional under 35 U.S.C. § 285, that Plaintiff’s damages be trebled, and that Plaintiff be awarded attorney’s fees and costs;

c) That Plaintiff be awarded damages adequate to compensate for Defendant’s infringement of the ’856 patent, including, e.g., lost profits, but in no event less than a reasonable royalty;

d) That Plaintiff be awarded pre-judgment and post-judgment interest;

e) That this court enjoin Delta Scientific, its officers, directors, principals, agents, servants, employees, successors, assigns, affiliates, and all that are in active

concert or participation with Delta Scientific, or any of them, from further infringement of the '865 patent;

f) That costs and expenses in this action be awarded to Plaintiff; and

g) For such further and other relief as the Court may deem appropriate.

DEMAND FOR JURY TRIAL

Plaintiff demands a trial by jury on all issues so triable.

MAYNARD COOPER & GALE LLP

Dated: July 12, 2019

By: /s/ Sasha G. Rao
Sasha G. Rao

EXHIBIT A

US008215865B2

(12) **United States Patent**
Adler et al.

(10) **Patent No.: US 8,215,865 B2**
(45) **Date of Patent: Jul. 10, 2012**

(54) **ANTI-RAM SYSTEM AND METHOD OF INSTALLATION**

(75) Inventors: **Richard S. Adler**, Upland, CA (US); **John Crawford**, Burbank, CA (US)

(73) Assignee: **RSA Protective Technologies, LLC**, Upland, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/694,730**

(22) Filed: **Jan. 27, 2010**

(65) **Prior Publication Data**

US 2010/0166498 A1 Jul. 1, 2010

Related U.S. Application Data

(63) Continuation of application No. 11/191,251, filed on Jul. 26, 2005, now Pat. No. 7,699,558.

(60) Provisional application No. 60/591,018, filed on Jul. 26, 2004, provisional application No. 60/600,955, filed on Aug. 12, 2004, provisional application No. 60/605,959, filed on Aug. 30, 2004, provisional application No. 60/622,385, filed on Oct. 26, 2004, provisional application No. 60/674,965, filed on Apr. 25, 2005, provisional application No. 60/679,547, filed on May 9, 2005.

(51) **Int. Cl.**
E01F 13/00 (2006.01)

(52) **U.S. Cl.** **404/6**; 256/13.1

(58) **Field of Classification Search** 404/6, 9–11; 256/13.1

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,203,006	A		10/1916	Keenan	
1,449,518	A	*	3/1923	Lawson	256/13.1
1,969,845	A	*	8/1934	Hick	256/13.1
2,958,926	A	*	11/1960	Morison	29/838
D233,219	S		10/1974	O'Donnell	
3,856,268	A		12/1974	Fitch	
3,934,540	A	*	1/1976	Bruner et al.	116/63 P
4,062,149	A		12/1977	Collins	49/49
4,515,499	A		5/1985	Furiate	
4,576,508	A		3/1986	Dickinson	
4,822,207	A		4/1989	Swahlan	
4,828,424	A	*	5/1989	Crisp, Sr.	404/6

(Continued)

FOREIGN PATENT DOCUMENTS

DE 34 12354 10/1985

(Continued)

OTHER PUBLICATIONS

PCT International Preliminary Report on Patentability, Apr. 3, 2007, 5 pgs.

(Continued)

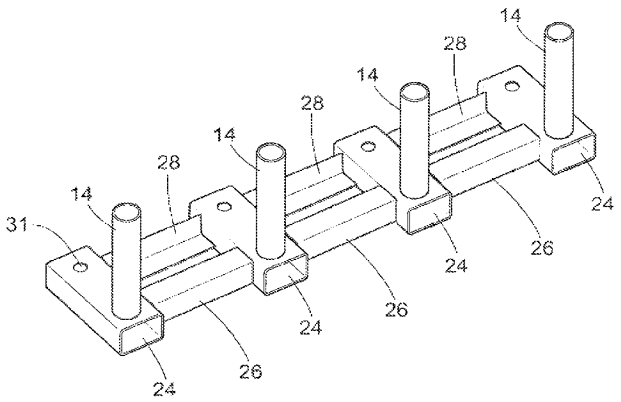
Primary Examiner — Raymond W Addie

(74) *Attorney, Agent, or Firm* — Frank J. DeRosa; Frommer Lawrence & Haug LLP

(57) **ABSTRACT**

An anti-ram system and method of construction having a shallow mounted base pad from which extend a plurality of bollards. Very little or only a shallow excavation is required for the base of the bollard system, which can be partially or fully assembled prior to bringing it to the installation site. The shallow mounting pad or base of the bollard system of this invention may be formed or constructed in various ways and of various materials, and in various configurations. The shallow mounting pad or base is constructed so as to have considerable mass.

35 Claims, 17 Drawing Sheets



U.S. PATENT DOCUMENTS

4,934,097	A	6/1990	Quante	49/49
5,006,008	A	4/1991	Bishop	
5,201,599	A	4/1993	Kulp et al.	
5,354,037	A	10/1994	Venegas, Jr.	
5,860,762	A	1/1999	Nelson	
5,961,249	A	10/1999	Hansen et al.	404/9
6,219,991	B1	4/2001	Salek-Nejad	
6,341,877	B1	1/2002	Chong	
6,367,208	B1 *	4/2002	Campbell et al.	52/169.13
6,454,488	B1	9/2002	Lewis, Sr. et al.	
6,702,512	B1	3/2004	Reale	404/6
6,805,515	B2 *	10/2004	Reale	404/11
7,118,304	B2 *	10/2006	Turpin et al.	404/6
2003/0127636	A1	7/2003	Piron	
2004/0033106	A1 *	2/2004	Turpin et al.	404/6
2004/0067104	A1	4/2004	Venegas	
2004/0190990	A1	9/2004	Blair	
2005/0201829	A1	9/2005	Dehart	
2006/0090408	A1 *	5/2006	Darcy	52/174
2008/0205982	A1	1/2008	Peng	404/6
2008/0038056	A1	2/2008	Patel	404/6
2008/0122756	A1	5/2008	Kawasaki et al.	345/76
2009/0028638	A1	1/2009	Crawford et al.	404/6
2009/0035061	A1	2/2009	Crawford et al.	404/6
2009/0250674	A1 *	10/2009	Darcy	256/13.1

FOREIGN PATENT DOCUMENTS

DE	4004851	*	2/1990
EP	0009235		4/1980
EP	0 955 414		11/1999
EP	1 054 108		11/2000
EP	1 479 826	A2	11/2004
FR	2057107		4/1971
GB	2 194 577	A	3/1988
GB	2 229 472		9/1990
JP	10176314		6/1998
JP	11061746		3/1999
JP	2001295298		10/2001
WO	WO 02/081824		10/2002

OTHER PUBLICATIONS

International Search Report, Mar. 20, 2007, 1 pg.
http://web.archive.org/web/20020525043057/http://globalsecurity.org/military/library... dated Feb. 12, 2007, 9 pgs.
Department of Defence Handbook, "Selection and Application of Vehicle Barriers" MIL-DDBK-1013/14, Feb. 1, 1999.

* cited by examiner

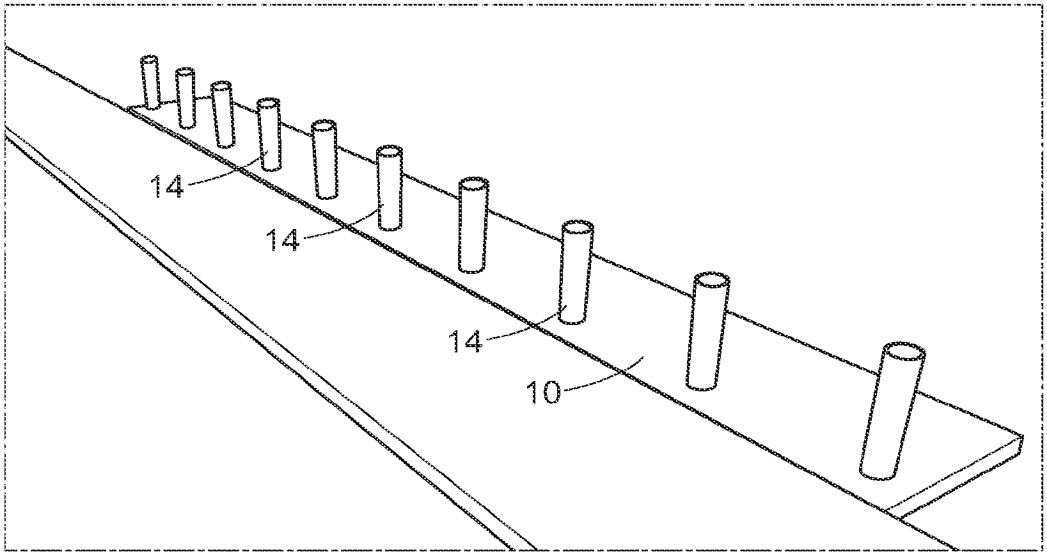


FIG. 1

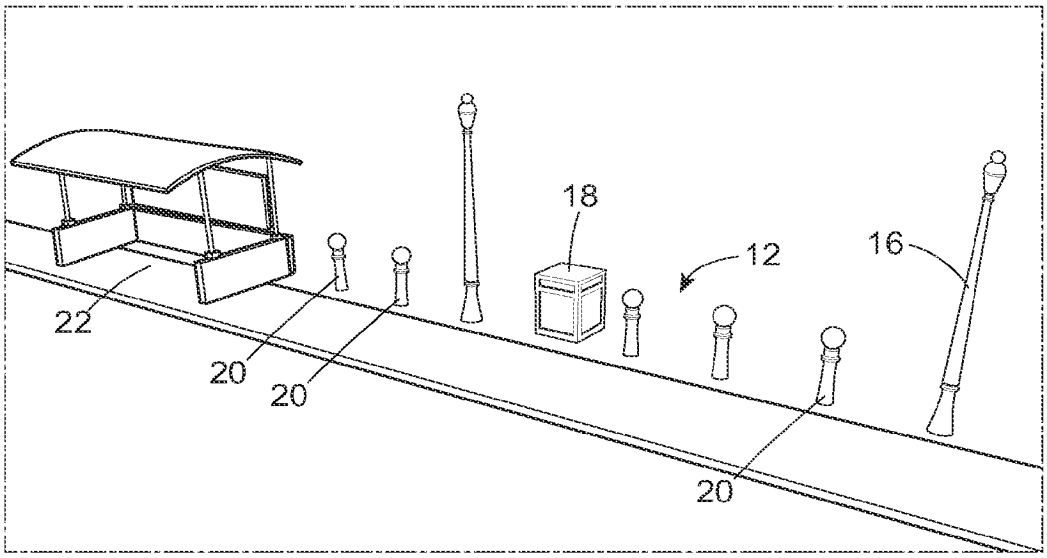


FIG. 2

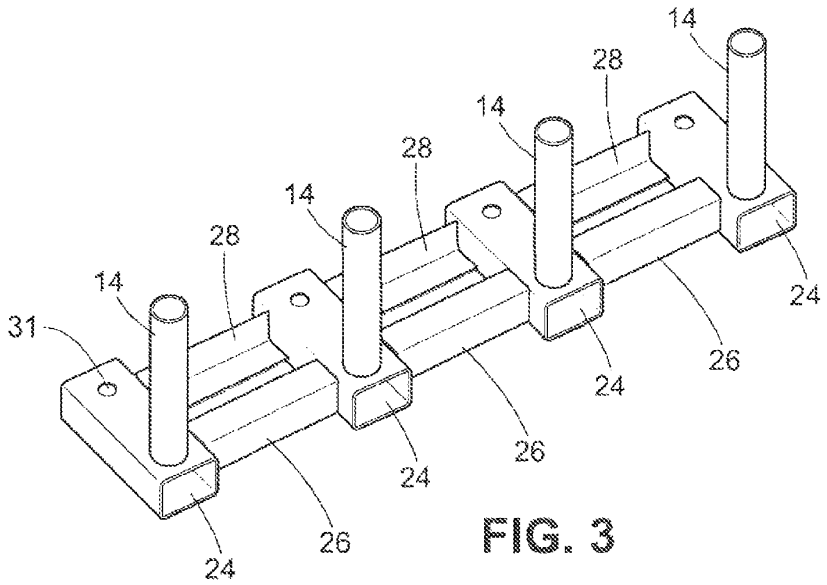

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FIG. 3

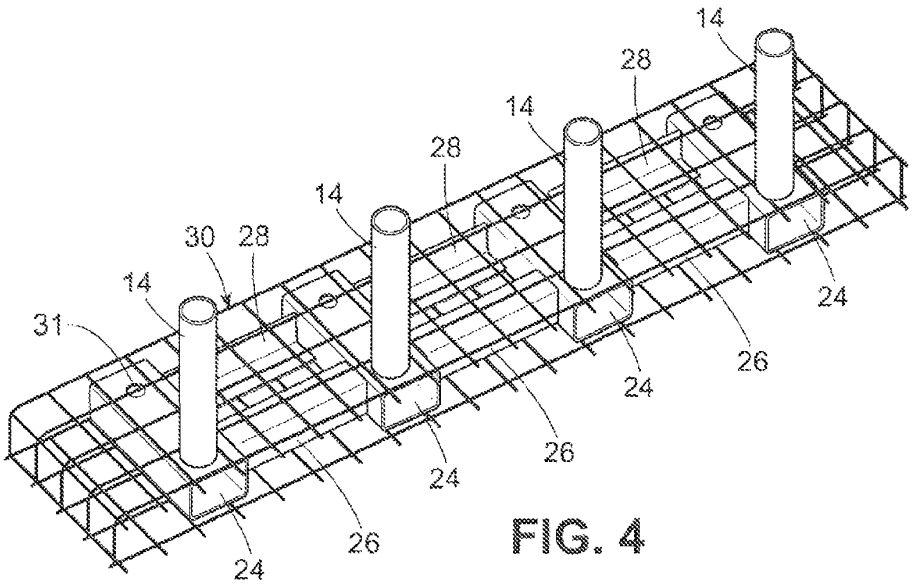
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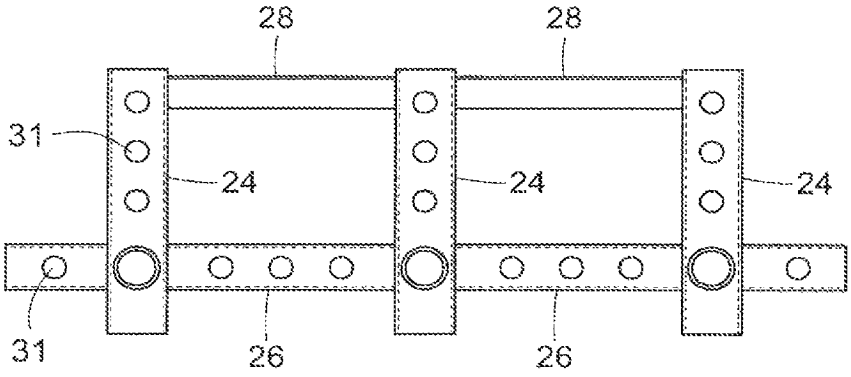
FIG. 4



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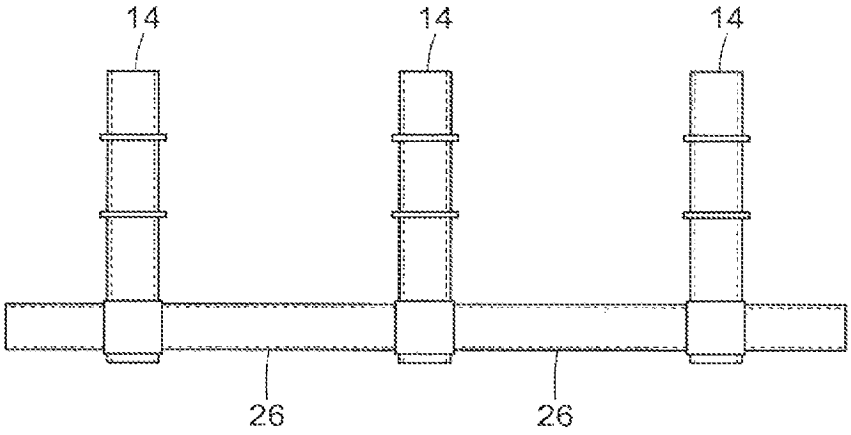

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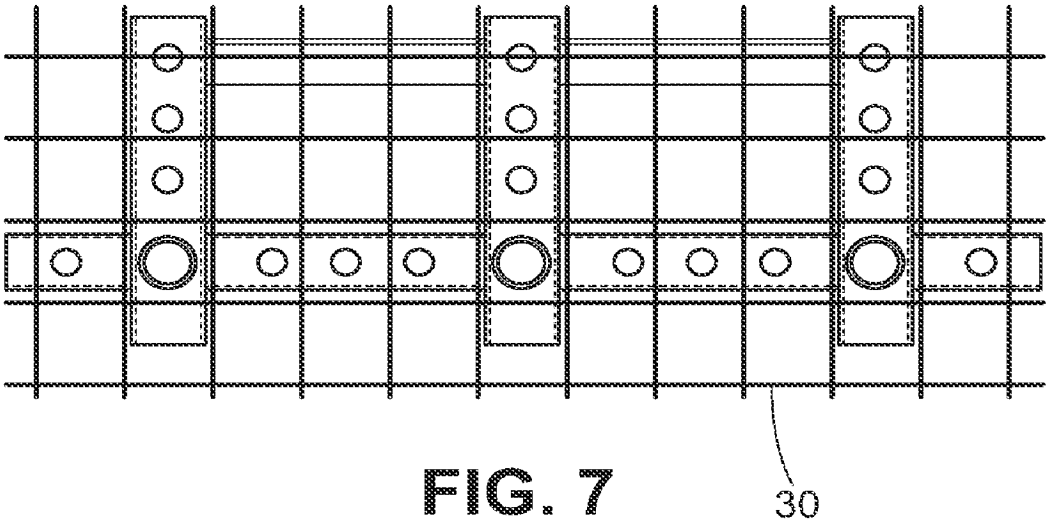

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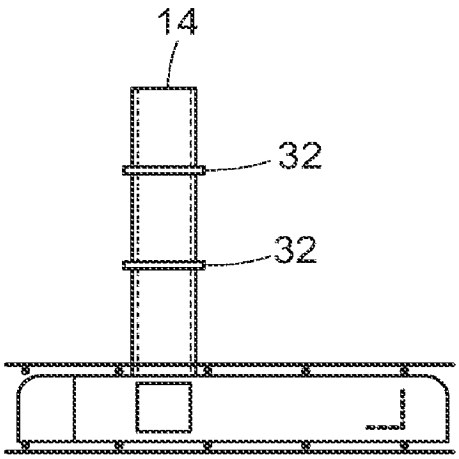

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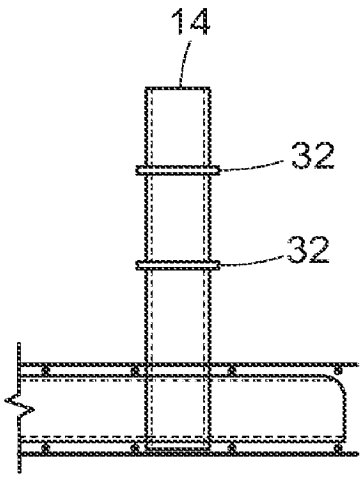

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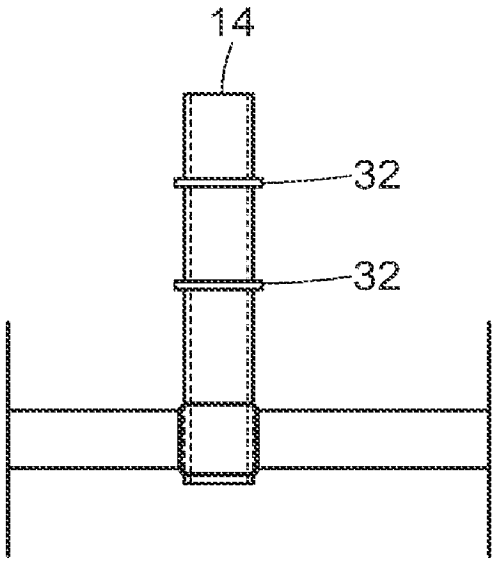

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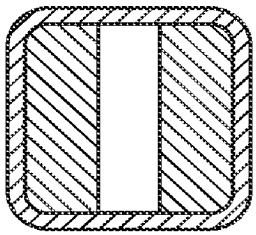

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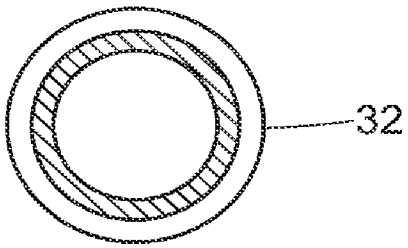

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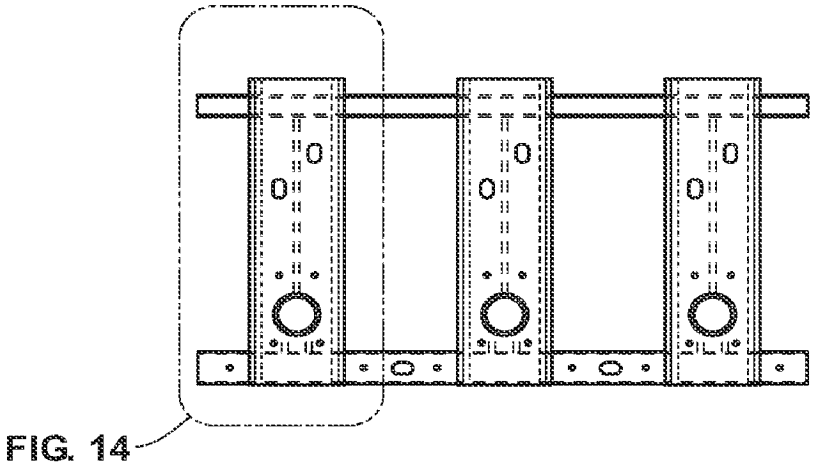


FIG. 14

FIG. 13

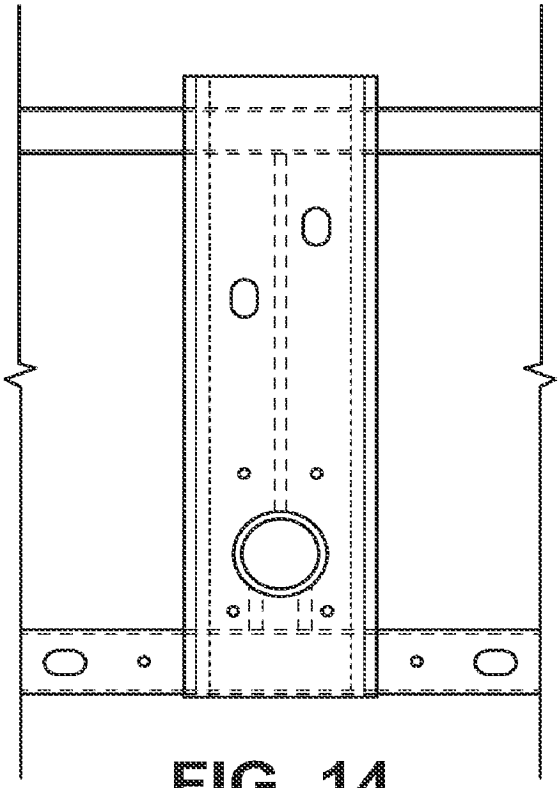
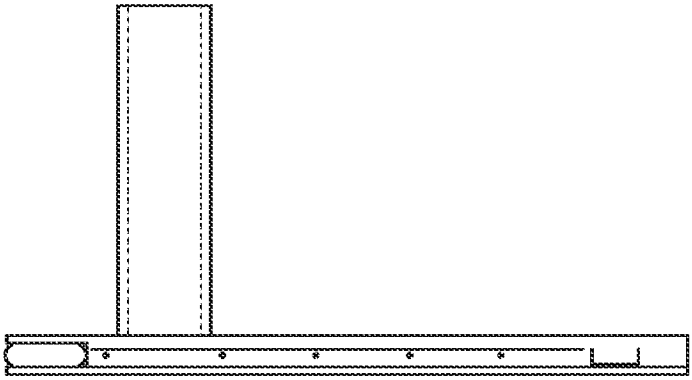
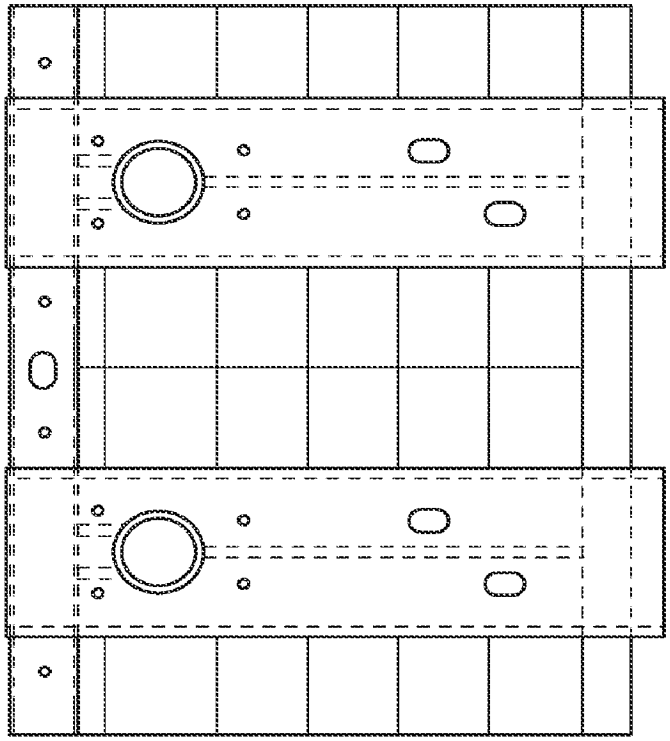


FIG. 14

FIG. 15





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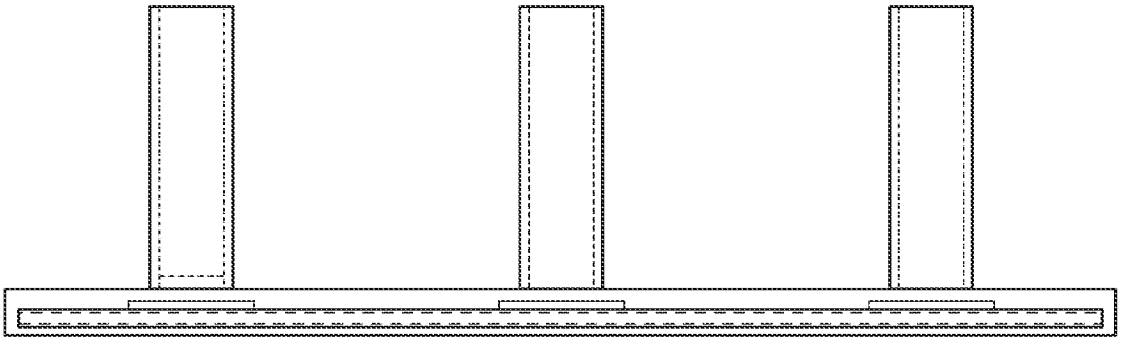

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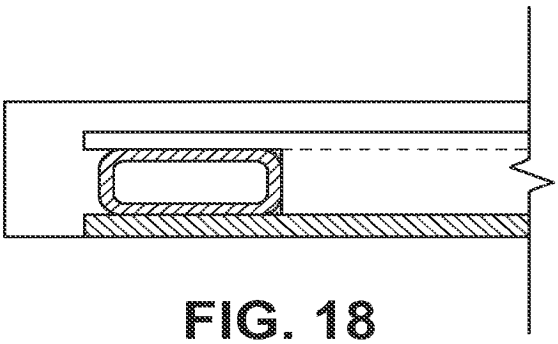

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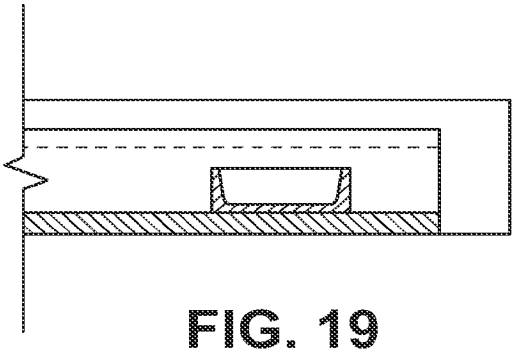

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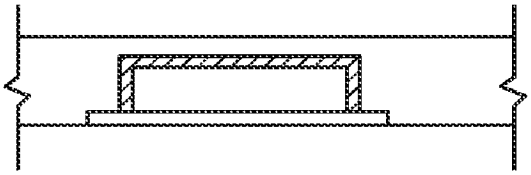
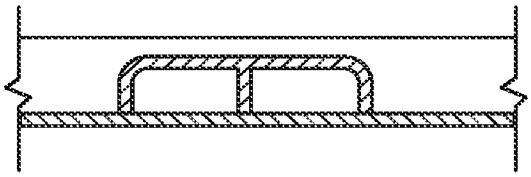


FIG. 20



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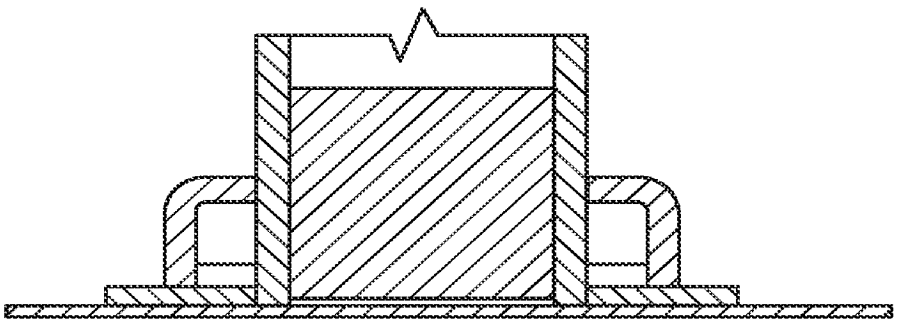

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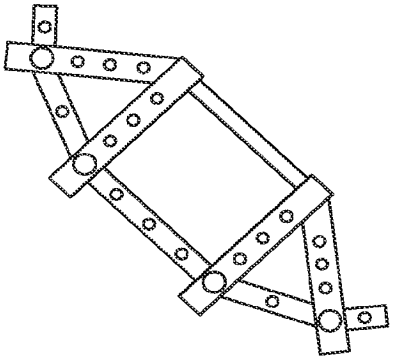

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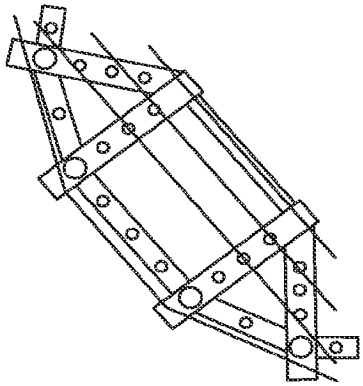


FIG. 25

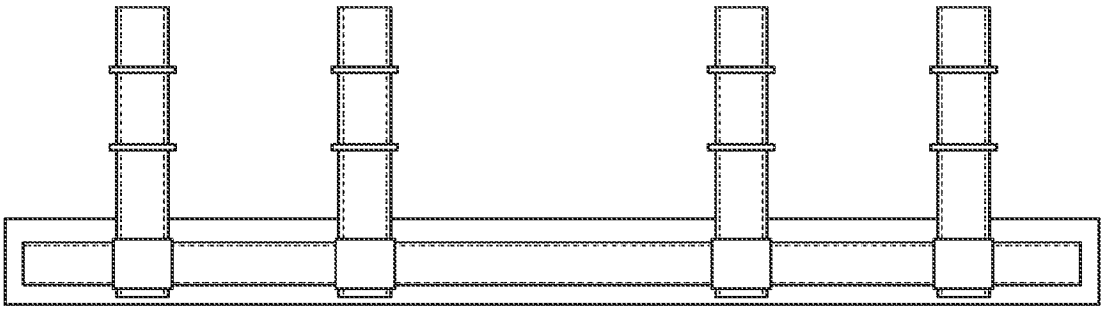


FIG. 24

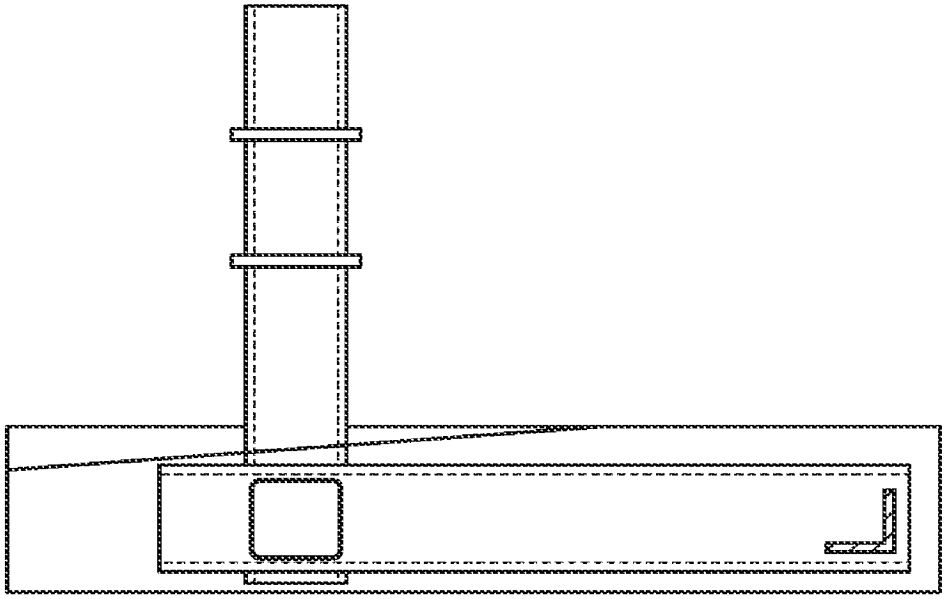


FIG. 26

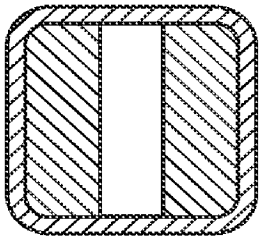


FIG. 27

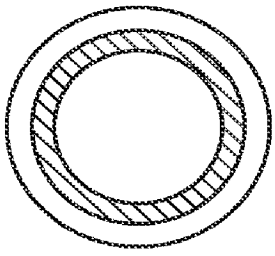


FIG. 28

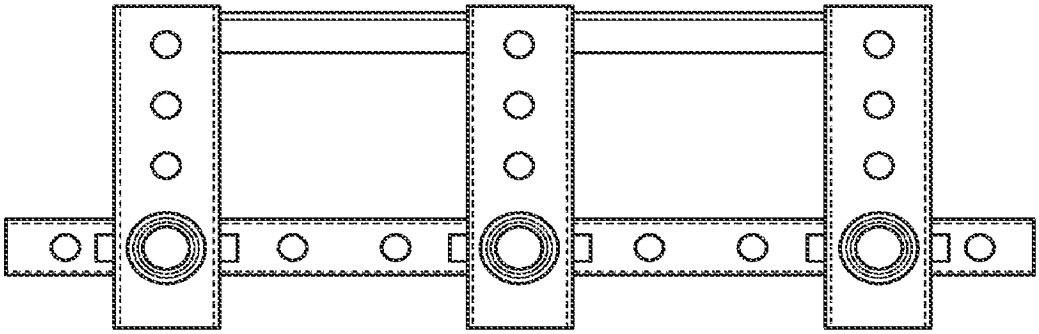


FIG. 29

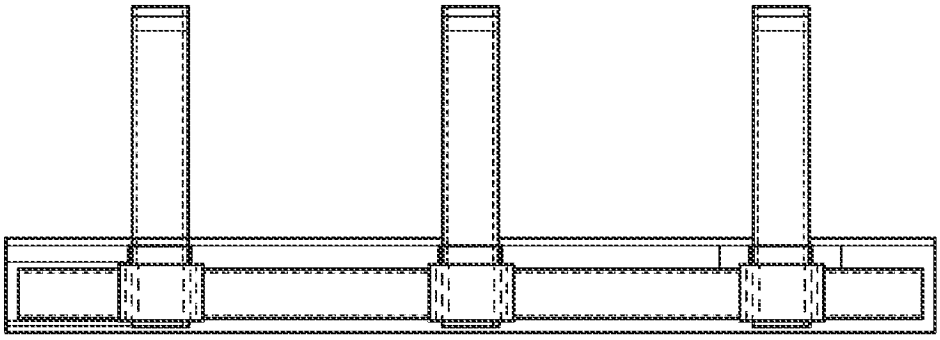
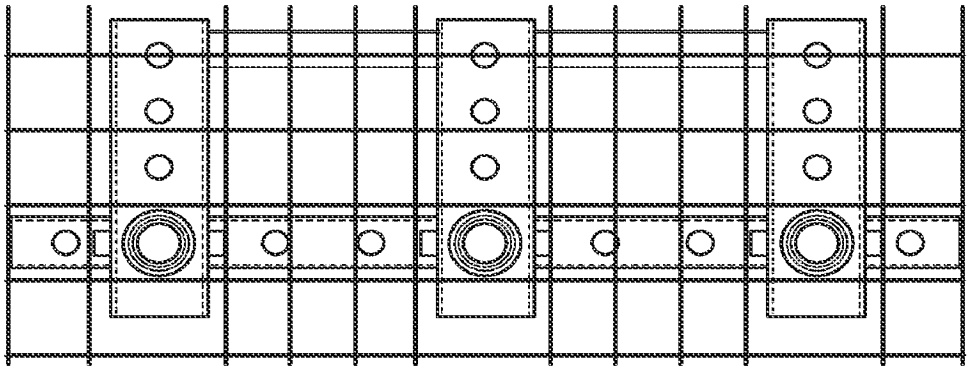


FIG. 30



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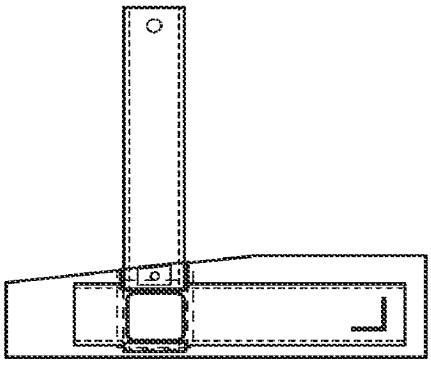

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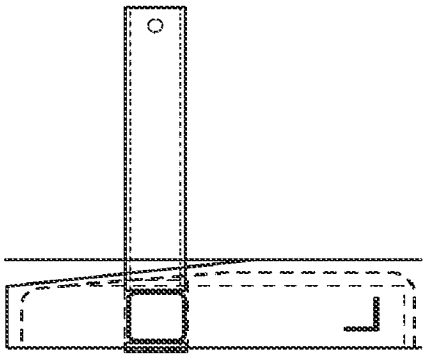

FIG. 33

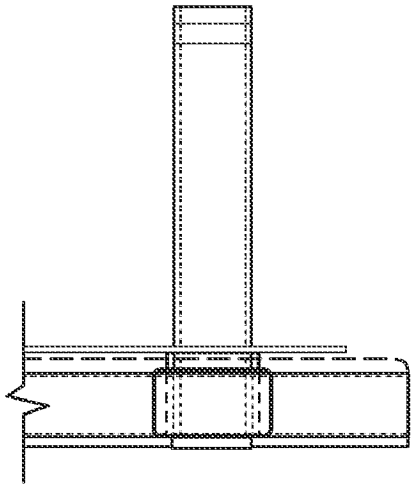

FIG. 34

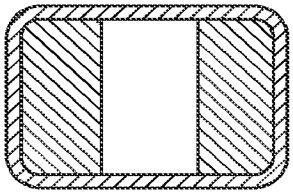

FIG. 35

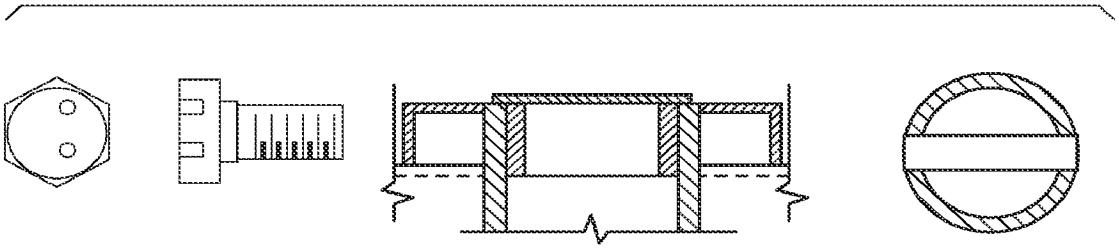

FIG. 36

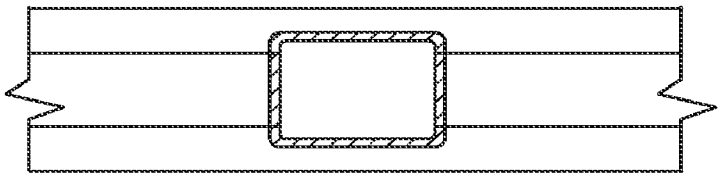

FIG. 37

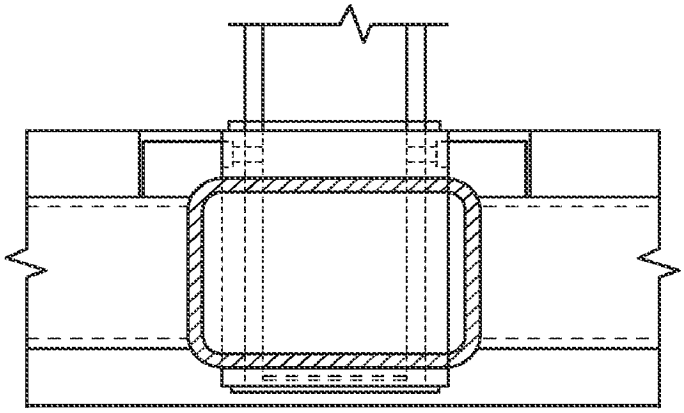

FIG. 38

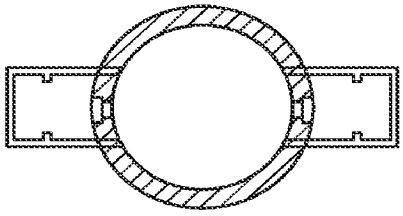

FIG. 39

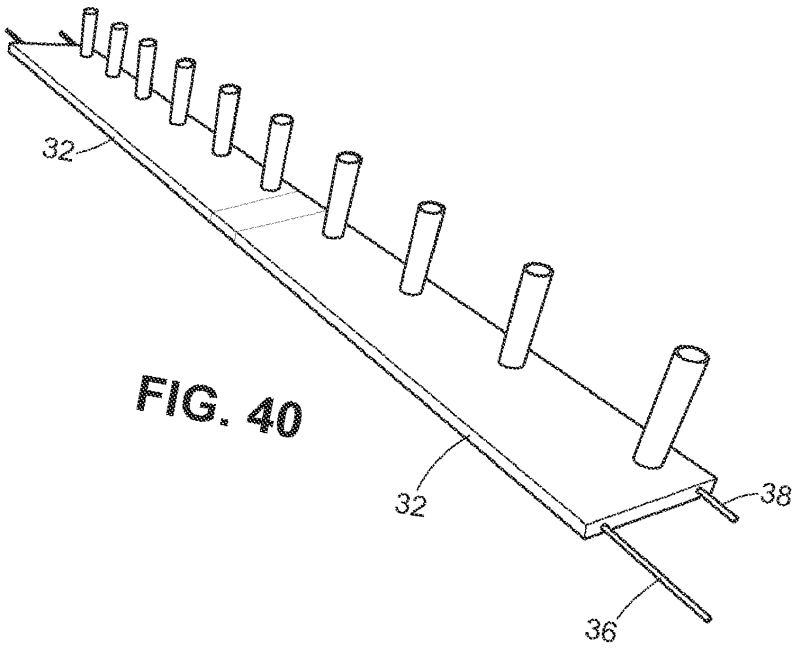

FIG. 40

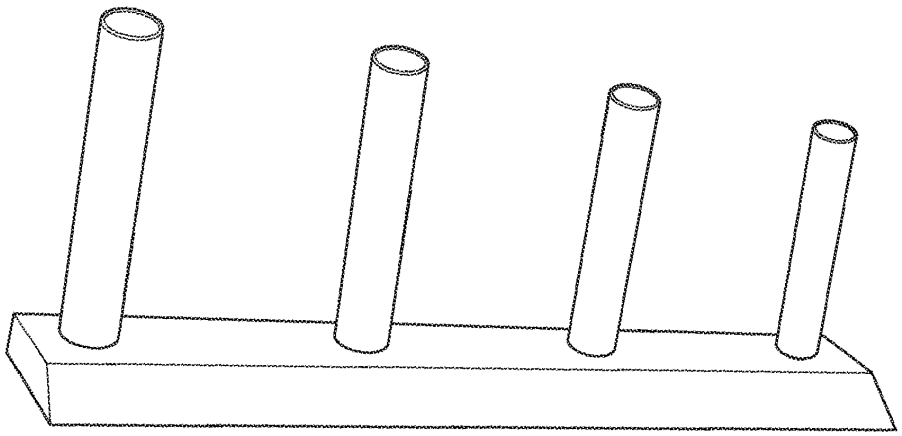

FIG. 41

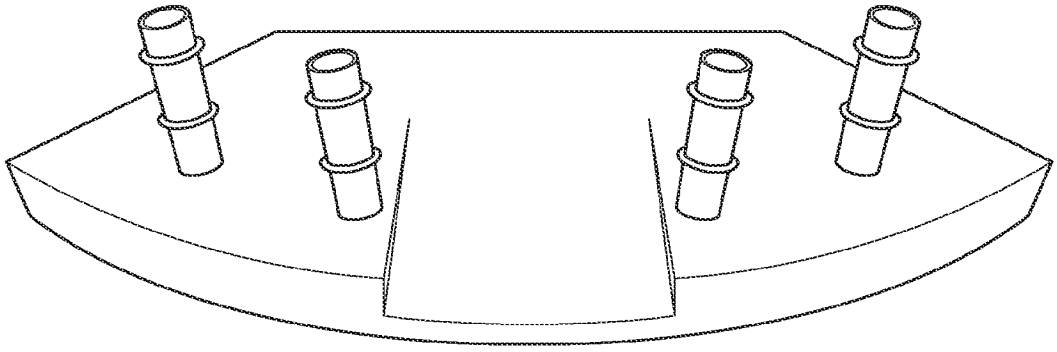

FIG. 42

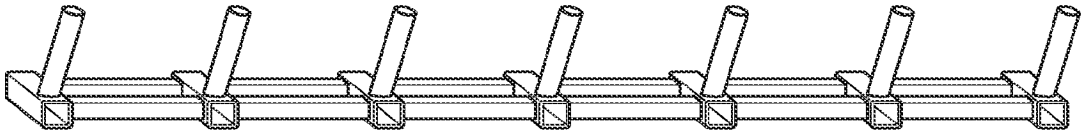

FIG. 43

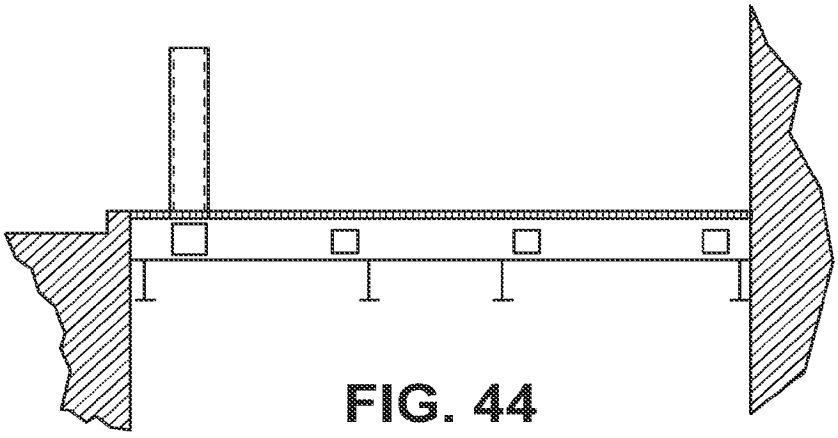

FIG. 44

ANTI-RAM SYSTEM AND METHOD OF INSTALLATION

CROSS-REFERENCE TO RELATED APPLICATIONS

This Application is a continuation of and claims priority of U.S. application Ser. No. 11/191,251 filed Jul. 26, 2005, now U.S. Pat. No. 7,699,558, which claims the benefit of the six provisional patent applications identified below. This Application also claims the benefit of these six provisional patent applications identified below, and incorporates herein by reference the entire contents and teachings of the six provisional patent applications identified below and the entire contents and teachings of application Ser. No. 11/191,251. The six provisional patent applications are:

U.S. Application No. 60/591,018 for Foundation module for anti-ram devices where subsurface clearances are minimal, by Richard Steven Adler and John Crawford, filed Jul. 26, 2004.

U.S. Application No. 60/600,955 for Anti-ram foundation pad, by Richard Steven Adler and John Crawford, filed Aug. 12, 2004.

U.S. Application No. 60/605,959 for RSA/K&C anti-ram foundation pad, by Richard Steven Adler and John Crawford, filed Aug. 30, 2004.

U.S. Application No. 60/622,385 for RSA/K&C anti-ram foundation pad with attached surface elements, by Richard Steven Adler and John Crawford, filed Oct. 26, 2004.

U.S. Application No. 60/674,965 for RSA/K&C anti ram bollards and RSA/K&C anti-ram headknocker, by Richard Steven Adler and John Crawford, filed Apr. 25, 2005.

U.S. Application No. 60/679,547 for RSA/K&C anti-ram bollard pad extension sleeves with integral structural integrity, by Richard Steven Adler, John Crawford and George Heyward, filed May 9, 2005.

FIELD OF THE INVENTION

The present invention relates to the assembly and installation of bollard systems for use in protecting building and other structures from being rammed by vehicles. It also relates to the adaption of bollard systems to varying installation requirements, and the disguising of the bollards to make them appear to be part of a normal landscape around a building or structure.

BACKGROUND OF THE INVENTION

A well know activity of terrorists is to crash a vehicle loaded with explosives or incendiary material into a building or other structure, so as to inflict damage to the building or other structure, and to harm the people in the building or structure. Various bollard constructions and methods of installation have been proposed and utilized in the past. Typically these bollard installations required rather deep excavations, several feet or more, to receive the base for a group of bollards. Alternatively, individual bollards were anchored by boring deep holes to receive the lower end of the bollard.

With the increased threat of terrorism, it has become desirable, and to some extend even necessary, to provide bollard protection to existing buildings in a well developed urban or commercial area. Typically it is desirable to locate the bollards between the building or other structure and the adjacent streets or roadways. Quite often buried below the surface of the space between a building or other structure and the street are utilities such as gas, water, electric, and telephone or other

communication lines and related components. Thus, to provide a deep excavation for the base of a bollard system is difficult if not impossible. While the underground utilities, could be moved to make way for the deep excavation for the base of a bollard system, to do so would be quite costly, and considerable construction time would be required. Such construction would not only most likely result in disruption of the utility services, but more so disrupts travel on the street and pedestrian traffic on the sidewalk between the building and the street.

It would therefore be desirable to provide a bollard system which would require very little or no excavation for the base of the bollard system, and which bollard system could be partially or completely preassembled and readily delivered to the installation site for placement and final assembly. It would be further desirable that the bollard system be readily adaptable to different terrain and installation requirements. For instance, it should be adaptable to installation on slopes, around corners, and in other none straight line applications. Further, it should meet installation requirements such as allowing for vents and access to underground vaults, and accommodating fire hydrants and street lighting poles. Further, it should provide for ramps for handicap access to the building or structure, and even for removal of one or more bollards to provide vehicle access to the building when occasionally needed.

SUMMARY OF THE INVENTION

In accordance with this invention, a bollard system is provided which requires very little or no excavation for the base of the bollard system, and which can be partially or fully assembled prior to bringing it to the installation site. The bollard system of this invention includes one or more bollards secured to a shallow mounting pad or base. The shallow mounting pad or base of the bollard system of this invention may be formed or constructed in various ways and of various materials. In all cases, the shallow mounting pad or base is designed to made of heavy materials, so as to have considerable mass.

The major benefit in the physics of the bollard system of this invention, is that the striking forces from the crash vehicle are transmitted from the bollard down to the shallow mount pad (5" to 14" in depth) in a way that is different from standard deep trench foundations (4' to 6'). The shallow mount pad is pushed down onto the soil (horizontal force backwards) instead of into the soil (vertical force downwards) as in the case of deep trench foundations.

The shallow base system makes for a much more effective and efficient load transfer into the soil which reduces the overall volume of displacement of soil by the base, as compared to the standard deep trench foundation systems. The shallow base system of this invention also provides a more efficient foundational system.

One of the issues with the deep trench system is that the lateral compliance at the top of the trench is quite low: If there is no strong resistive force at the top of the trench, then there is a greater chance of more rotation of the bollard which would permit the crash vehicle to breach the system, thereby obviating the crash control device. In the shallow mount bollard system of this invention, the resistive forces are all at the base of the bollard (at the top of the trench) and therefore reduce the likelihood of the bollard rotating and vehicle breaching the security system.

The bollard system of this invention works as the crash vehicle strikes the bollard near its top edge translating the forces from that impact to the base of the bollard. The forces

at the base of the bollard are transmitted to the foundation pad or base, and from there into the soil or concrete depending on what the unit is seated on. The resistance force is of the reverse order stated above.

The bollard system of this invention is able to become more shallow (14" to 6.5" to 3") by controlling the compliance supplied by the foundation to resist the rotation at the base of the bollard. Specifically the bollard system of this invention can utilize a more shallow trench by more efficiently transmitting the loads to the support media (soil or concrete). The more efficient transfer of the impact load is also accomplished by the addition of either one, a group or all of the following enhancements: 1) a wider base; 2) a heavier base; 3) longer base (laterally and tying adjacent units together); 4) increasing the efficiency of the grillage; 5) stiffer base; 6) ability to place bollard in different locations in the base (for example placing the bollard at the back of the base makes the system weaker), 7) the addition of internal stiffeners both inside the tubes forming the base and inside the pipe forming the bollard, and 8) others.

While in the preferred embodiment of this invention the base or pad is rectangular, other shapes can be used, such as angled and curved bases, zigzags, and indented, so as to go around an appurtenance.

In the preferred embodiment of this invention the frame or grill of the base and the bollards are formed of structural steel members. The amount of weldment required to assemble the frame or grill of the base and the bollards is dependant upon the availability of stock or over the counter materials. If more stock or over the counter materials are usable and available then less weldment is required to connect pieces and create a stronger base grillage.

Another major benefit of the shallow trench system of this invention is realized in its accommodation of site constraints (such as not interfering with underground utilities, able to install at sites where there is limited access to underground excavation (presence of vaults, basements), not interfering with vegetation, etc.

The base or pad in a preferred embodiment or the bollard system of this invention is constructed using a series of structural tubes to form a grillage (ie. pipes, tubes, channels and sometimes angles) to produce rigidity of the pad or base against upheaval and torsion forces. The grillage is a framework for supporting the load imparted by the bollard. The framework means the tubes (or other structural steel elements) tied together to form the grillage. The base or pad is completed on site, by filling the shallow excavation and grillage with concrete to form a finished foundation unit. It is preferred that the concrete be in contact with the soil or existing concrete at the base of the excavation in order to improve the resistance of the lateral motion of the pad. The top surface of the pad is to be formed in such a way to support the materials forming the final finished appearance (non-structural stone pavers or tiles, etc.).

The shallow base or pad concept of this invention differs from the standard deep trench system because it only requires a simple replacement of area near the surface, thereby significantly reducing the interference with any existing underground objects at the site. Unlike a deep trench footing, detailed inspection of pre-existing underground conditions, are not required. With the standard trench, personnel inspectors and multiple tools are required to hold the trench open, issues also arise with rain water or other media spilling into the trench.

The physics of the interaction of the base or pad of the bollard system of this invention with supporting media (soil or concrete) is different than that of the deep trench system, in that the forces imparted by the pad or base are much less than the forces imparted by the deep trench foundation. This is partly due to the large support area of the pad as compared to the deep trench foundation—the vertical forces being carried by the bottom edge of the trench foundation and the horizontal forces being carried by the top few inches of the trench foundation in a deep trench foundation, as compared to the horizontal forces being provided by the frictional forces being between the pad and media over the entire area of the pad and the vertical forces between the pad and media being carried over the entire area of the pad. The area of the pad or base in the bollard system of this invention may be reduced by the addition of engineered stiffeners, tying adjacent pads together, larger section modulus parts, larger welds, etc.

Restated, the area of a deep trench foundation interacting with the media is significantly smaller than the area of the pad interaction with the media in the system of this invention, thus the forces transferred to the media are far less than the forces transferred by the trench footing to the media. The pad or base of this invention spreads the forces out while the deep trench footing concentrates the forces which require the trench footing to be massive and deep. The deep trench footing for comparable performance will always have to be more massive than the pad or base of this invention.

The pad or base of the bollard system of this invention is superior in design because it transmits the load more efficiently to the foundation (ground) than a deep trench design, thus allowing a smaller device to absorb the same or greater amount of energy than a more onerous design.

The shallow pad or base of the bollard system of this invention supports the development of corner units with inherent advantages over a deep trench foundation. The shallow base of the system of this invention allows for complex geometry at corners, thereby facilitating ADA access and foot traffic by allowing bollards to be placed in an optimal pattern for pedestrian traffic without regard to the excavation needed to support the bollards. This is achieved by taking advantage of the flexibility in bollard placement offered by the grillage concept that allows the bollards to be placed anywhere in the grillage. Whereas with deep trench footing, the bollards necessarily need to be lined up with the trench itself. In order for the deep trench to support out of line placement of bollards, it would have to be the full width of the bollard pattern whereas only an excavation of the shape of that pad needs to be made in accordance with this invention.

The flexibility of the bollard system of this invention permits the extension of a pad in any one direction for any unique situation for the bollard to be supported by the pad, but not beyond the pad. This is achieved by extending a tube connected to the grillage in any desired direction and placing (anchoring) a bollard in the tube.

In certain situations, site encumbrances may not allow a pad or base to be used where it is desirable to place one or more bollards. Extending one or more horizontal connector tubes between spaced pads achieves the necessary anti-ram capability without requiring additional excavation for the pad itself. In a specific embodiment, a connector tube, either above or below ground, can be secured at its ends to the grillage of two adjacent pads with the ends of one or more bollards placed in vertical holes formed in the connector tube. The physics behind this inventive concept is that the torsional rigidity of the connector tube is being used to resist the motion of the bollard, instead of upheaval or moment resistance of the tube used in the standard pad design. That is, when a vehicle strikes the bollard in the conventional design the tube supporting the bollard on axis with the impact is the tube that resists the motion of the bollard using its moment capacity,

while in this alternate construction, the tube resists the motion of the bollard with its torsional capacity, bending not twisting.

Another variation of this invention provides removable units in which the bollard is temporarily removed for access through the on-center spacing and then replaced for its anti-ram purpose. The method to achieve this without a fixed bottom weld is the addition of an extra thick steel sleeve connected to the base of the grillage, with the bollard being slipped into and out of the sleeve. Additional bolts or a variation of locking mechanisms provide security to prevent unauthorized personnel from removing the removable bollard.

When using the shallow base of pad system of this invention, it may be necessary to place the pad over an air vent or access open to an underground space. To accommodate this need, the grillage is formed to provide an open space located over the air vent or access opening. A form is provided around the open space, such that when concrete is introduced into the grillage, it does not enter the open space. Once the base of the pad system is completed, the usual grate or grill can be placed over the opening.

While it is desirable in accordance with this invention to have the pad extend further in the direction of expected impact, that is on the opposite side of the bollard from the side of impact, than on the side of impact, some applications may require a reversal of the extension. For instance, if it becomes necessary to move the bollards farther away from the road, that is closer to the building being protected, a bollard unit in accordance with this invention may be lifted, rotated 180 degrees and replaced. This rotation will place the bollards closer to the building and farther away from the road. The bollard system of this invention also makes possible the temporary removal of the bollards and the supporting base. For instance, if it becomes desirable to access something under the bollards, the bollards and connected base may be lifted and temporarily removed. This would not be feasible with a deep trench bollard system.

The bollard system of this invention does not lend itself to the installation of a single bollard, since without an extended base or pad, there is not sufficient resistance to stop the rotation of the pipe bollard. However, a feature of this invention is to provide a single bollard with a supporting pad, such that if a single bollard is damaged in a row of bollards, the damaged bollard and its supporting pad may be cut out of the row of bollards and the supporting pad of the single replacement bollard secured to supporting pads of the adjacent bollards.

In its most basic form the bollard system of this invention would have its base or pad formed of a continuous flat piece of steel with holes cut out for the bollards. The plate would need a minimum depth 5" to qualify as a DOS rated system. The cross pieces are inherent in the continuous plate. Still another basic configuration of the bollard system of this invention is to bolt separate thick pieces of steel to continuous cross plates, and to have the bollard set inside that construction. Again, 5" thick steel would be required to have two plates 5" apart.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the anti-ram system of this invention installed alongside the edge of a sidewalk, prior to the pad being covered with a landscaping surface;

FIG. **2** is a perspective view of the anti-ram system of this invention as shown in FIG. **1**, with a landscaping surface applied over the pad, and with the bollards covered by ornamental and functional items;

FIG. **3** shows an embodiment of this invention with four bollards mounted on the framework for the pad or base of the anti-ram system;

FIG. **4**, shows the embodiment of this invention shown in FIG. **3**, with a rebar cage surrounding the framework for the pad or base;

FIG. **5** is a top plan view of the steel layout for the base of a set of three bollards in accordance with a preferred embodiment of this invention;

FIG. **6** is a side elevation view of the steel layout of FIG. **5**;

FIG. **7** is a top plan view of the steel layout shown in FIG. **5**, showing in addition the layout of rebars forming a grill or cage around the rebars;

FIG. **8** is a side elevation view of the steel and rebar layout shown in FIG. **7**;

FIG. **9** is an end elevation view of the steel and rebar layout shown in FIG. **7**;

FIG. **10** is an end elevation view of the steel layout of FIG. **5**;

FIG. **11** is an end plate detail of the steel layout of FIG. **5**;

FIG. **12** is a cover strip shown encircling the bollards in FIGS. **6** and **8-10**;

FIG. **13** is a top plan view of the steel layout for the base of a set of three bollards in accordance with a second preferred embodiment of this invention;

FIG. **14** is a detailed top plan view of the steel layout encircled by the line A-A in FIG. **13**;

FIG. **15** is a typical section view of the steel layout shown in FIG. **12**;

FIG. **16** is a top elevation view similar to FIG. **13**. Showing the steel and rebar layout;

FIG. **17** is a typical elevation view of the steel and rebar layout shown in FIG. **16**;

FIG. **18** is a cross-sectional view of the longitudinal tubular member located adjacent to the bollards in FIG. **13**;

FIG. **19** is a cross-sectional view of the longitudinal channel member located at the rear end of the transversely extending members in FIG. **13**;

FIG. **20** is a detail of a front stiffener as used in the transversely extending member shown in FIG. **13**;

FIG. **21** is a detail of a rear stiffener as used in the transversely extending member shown in FIG. **13**;

FIG. **22** is a cross-sectional view of the support arrangement for the bollard tube, including a solid circular steel bar in the center of the tube;

FIG. **23** is a top elevation view showing the layout of the steel members for forming the framework for a pad designed to support bollards at a corner;

FIG. **24** is a side elevation view of the corner pad and bollards shown in FIG. **23**;

FIG. **25** is a top elevation similar to FIG. **23** showing the location of rebars used in the corner;

FIG. **26** is a side elevation view of the corner pad and rebars as shown in FIG. **25**;

FIG. **27** is a cross-section view showing a stiffener place in the end of the transversely extending members shown in FIG. **23**;

FIG. **28** is a cross-sectional view of the support arrangement for a bollard in the framework shown in FIG. **23**;

FIG. **29** is a detailed top plan view of the steel frame layout for a pad in accordance with this invention wherein the bollards are removable so as to provide access to the protected structure;

FIG. **30** is a side elevation view of the steel frame shown in FIG. **29**, showing the reinforced steel socket provided for receiving the lower end of a bollard;

FIG. **31** is a detailed top plan view similar to FIG. **29** showing the placement of the rebars on the steel frame;

FIG. **32** is side sectional view of the steel frame and bollard shown in FIG. **29**;

FIG. **33** is an end view of the steel frame and bollard shown in FIG. **29**;

FIG. **34** is an end sectional view of the frame reinforce steel socket and bollard as shown in FIG. **29**:

FIG. **35** is a cross-section view showing a stiffener place in the end of the transversely extending members shown in FIG. **29**;

FIG. **36** show an arrangement including a bolt for securing a bollard in a socket as shown in FIG. **29**;

FIG. **37** is a cross-sectional view of a typical end section of the steel frame shown in FIG. **29**;

FIG. **38** is an detailed cross-sectional view of the socket and locking or securing arrangement for a bollard mounted in the steel frame shown in FIG. **29**;

FIG. **39** is a cross-sectional view shown the enclosure provide for the locking or securing arrangement shown in FIG. **36**;

FIG. **40** is a perspective view of still another embodiment of this invention;

FIG. **41** shows still another embodiment of this invention, wherein the pad or base is surface mounted;

FIG. **42** is a perspective view of a corner or curved bollard system in accordance with this invention wherein the base is formed with a ramp for handicap access;

FIG. **43** is a perspective view of a steel frame formed for the base of a bollard system of this invention which is intended for placement on a slope; and

FIG. **44** is a perspective view of an embodiment of this invention wherein an opening is left is the base of the bollard system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** shows an embodiment of the anti-ram system of this invention installed in a shallow trench alongside a sidewalk. The top surface **10** of the base or pad of the anti-ram system is shown recessed below the desired grade level. As shown in FIG. **2**, a landscaping surface, such as grass **12** is placed over the top surface **10** of the base or pad. As further shown in FIG. **2**, ornamental or functional objects are placed over the bollards **14** shown in FIG. **1**. Such objects include lamp posts **16**, waste container **18**, ornaments **20**, and a seat and shelter **22**. The ornamental and functional items disguise the presence of the bollards of the anti-ram system.

FIG. **3** shows an embodiment of this invention with four bollards **14**, mounted on the steel framework **23** for the pad of the anti-ram system. The framework **23** includes transversely extending tubular members **24**, longitudinally extending tubular members **26**, and longitudinally extending angle members **28**. In a preferred embodiment of this invention, the tubular members **24** and **26** have a rectangular cross-section, such that they form a generally planar upper and lower surface for the pad. The longitudinally extending tubular members **26** are welded to the sides of the transversely extending tubular members **24**. Depending on the strength requirements of a particular anti-ram system, the welds can be fillet welds or full penetration welds on all four sides of the tubular members **26**. Similarly, the longitudinally extending angle members **28** are welded to the sides of the tubular members **24** by either full penetration or fillet welds. Alternatively, angular notches can be cut in the transversely extending tubular members **24** for the longitudinally extending angle member to pass through, in which case the angle member may be formed as one continuous piece. Holes are provided in the transversely extending tubular members **24** to receive the cylindrical bollards **14**. Again, the cylindrical bollards are secured to the tubular members **24** by fillet or full penetrations welds at both the upper and lower surfaces of the tubular members **24**. Apertures **31** are provided in both tubular members **24** and **26**, such that they may be filled with a material such as concrete, to add strength and weight to the base or pad.

FIG. **4**, which is similar to FIG. **3**, shows a rebar cage, or grillage **30** placed around the steel framework **23**. The rebar cage includes an upper portion on top of the tubular members **24** and **26** and a lower portion under the tubular members **24** and **26**. The rebars forming the cage **30**, are welded to the tubular member **24** and **26**.

FIG. **5** shows a top plan view of a framework for a typical set of three bollards, and FIG. **6** shows a side elevation of the same framework constructed in accordance with this invention. FIG. **7** shows an elevation view of a rebar cage or grillage secured to the framework shown in FIG. **5**. FIG. **8** is a typical side section view of the rebar cage and framework shown in FIG. **7**, and FIG. **9** is a typical front end section view, while FIG. **10** is a typical rear end section view. FIG. **11** is a cross-sectional detailed view of an end plate secured in the tubular member **24**. A gap is provided in the end plate to provide for the filling of the tubular member with a material such as concrete. FIG. **12** is a detailed cross-section of one of the cover strips **32** provided on the bollards **14**. FIGS. **5-12** are representative of a base or pad system in accordance with this invention which requires the provision of an excavation approximately 14 inches deep. The steel framework has a height of approximately 10 inches, the rebar cage adding approximately ½ inch to the height, and the encapsulating concrete adding another 1 and ½ inch, for a total of 12 inches.

FIGS. **13-22** are similar to FIGS. **5-12** in showing details of a second preferred embodiment of this invention. In this embodiment the base or pad is considerable thinner than that shown in FIGS. **5-12**. In this embodiment the overall height of the pad could be only 6 and ½ inches, the steel frame having a height of 5 inches, with the rebar being located mid-height in the steel frame, rather that on the top and the bottom. The concrete adds 1 and ½ inches to the height of the pad.

Referring to FIGS. **23-28**, it can be seen that by forming triangles with the transversely and longitudinally extending tubular members, it is possible to form a curved line of bollards.

Referring to FIG. **40**, two bollard pads **32**, are shown spaced apart by a gap. Before the pads are filed with concrete, a pair of pipes are placed within the pads, such that post tensioning members can be passed through the pipes to secure the two bollard pads **32** to each other. Of course, any number of pads could be placed in alignment and secured by the post tensioning members.

Referring to FIG. **41**, the bollard system of this invention may be formed as a unit to be place on a surface for temporary bollard protection. The bottom surface is formed as a high friction surface, so as to resist sliding when an impact is received by the bollards.

Referring to FIG. **43** a perspective view of a steel frame formed for the base of a bollard system of this invention is shown, which is intended for placement on a slope. The bollards are secured to the base at an angle, such that when the base is placed on a slope, the bollards will be vertical.

FIG. **44** shows an embodiment of this invention wherein an opening is left in the base of the bollard system to provide for

an opening, such that when a grate is installed over the opening, an open space below the base is ventilated through the opening.

While only one embodiment of the invention has been shown, it should be apparent to those skilled in the art that what has been described is considered at present to be a preferred embodiment of the anti-ram system and method of installation of this invention. In accordance with the Patent Statute, changes may be made in the anti-ram system and method of installation of this invention without actually departing from the true spirit and scope of this invention. The appended claims are intended to cover all such changes and modifications which fall in the true spirit and scope of this invention.

The invention claimed is:

1. A bollard structure comprising:

at least one bollard; and

a base comprising opposed ends and a plurality of structural members which intersect and are tied together, for each bollard of the bollard structure at least one first structural member extending from a first of the opposed ends of the base to a second of the opposed ends of the base in a first direction intersecting with the opposed ends, and at least one structural member extending to intersect with the at least one first structural member;

each bollard being secured to at least one of the at least one first structural member and the at least one structural member of the base for the respective bollard and extending upwardly from the base so as to transmit forces applied to the at least one bollard to the base;

wherein the base is configured to be mounted in a shallow excavation with the at least one bollard extending above grade; and

wherein the at least one first structural member or the at least one structural member or both are configured or tied together to retain within the base supporting media introduced into the base when the base is mounted in the excavation such that the rotation is resisted of a bollard or bollards and the base from an impact against the bollard or bollards.

2. The bollard structure of claim **1**, wherein at least one of the opposed ends is formed by a structural member to which an end of the at least one first structural member is secured.

3. The bollard structure of claim **1**, wherein the intersecting structural members have axes that extend parallel to a plane of the base.

4. The bollard structure of claim **1**, wherein the base has a height of 3 inches to 14 inches.

5. The bollard structure of claim **1**, wherein the plurality of structural members comprise one or more tubular members.

6. The bollard structure of claim **5**, wherein at least one tubular member comprises a pipe.

7. The bollard structure of claim **5**, wherein at least one tubular member comprises a tube.

8. The bollard structure of claim **5**, wherein at least one tubular member comprises an angle.

9. The bollard structure of claim **5**, wherein at least one tubular member comprises a channel.

10. The bollard structure of claim **1**, wherein the plurality of structural members comprises at least one tube.

11. The bollard structure of claim **1**, wherein the plurality of structural members comprises at least one pipe.

12. The bollard structure of claim **1**, wherein the plurality of structural members comprises at least one angle.

13. The bollard structure of claim **1**, wherein the plurality of structural members comprises at least one channel.

14. The bollard structure of claim **1**, wherein the plurality of structural members comprises at least one plate.

15. The bollard structure of claim **1**, wherein the plurality of structural members comprise structural steel members.

16. A bollard structure comprising:

a plurality of bollards; and

a base comprising opposed ends and a plurality of structural members which intersect and are tied together, for each bollard of the bollard structure at least one first structural member extending from a first of the opposed ends of the base to a second of the opposed ends of the base in a first direction intersecting with the opposed ends, and at least one structural member extending to intersect with the at least one first structural member;

each of the plurality of bollards being secured to at least one of the at least one first structural member and the at least one structural member of the base for the respective bollard and extending upwardly from the base so as to transmit forces applied to the at least one bollard to the base;

wherein the base is configured to be mounted in a shallow excavation with the plurality of bollards extending above grade of the excavation; and

wherein the at least one first structural member or the at least one structural member or both are configured or tied together to retain within the base supporting media introduced into the base when the base is mounted in the excavation such that the rotation is resisted of a bollard or bollards and the base from an impact against the bollard or bollards.

17. The bollard structure of claim **16**, wherein at least one of the opposed ends is formed by a structural member to which an end of the at least one first structural member is secured.

18. The bollard structure of claim **16**, wherein the bollard structure is configured to resist impact from a direction of expected impact and the first direction is parallel to the direction of expected impact, and wherein each of the plurality of bollards is secured to at least one structural member that extends in the first direction.

19. The bollard structure of claim **16** wherein the intersecting structural members have axes that extend parallel to a plane of the base.

20. The bollard structure of claim **16** wherein the base has a height of 3 inches to 14 inches.

21. The bollard structure of claim **16**, wherein the plurality of structural members comprise one or more tubular members.

22. The bollard structure of claim **21**, wherein at least one tubular member comprises a pipe.

23. The bollard structure of claim **21**, wherein at least one tubular member comprises a tube.

24. The bollard structure of claim **21**, wherein at least one tubular member comprises an angle.

25. The bollard structure of claim **21**, wherein at least one tubular member comprises a channel.

26. The bollard structure of claim **16**, wherein the plurality of structural members comprises at least one tube.

27. The bollard structure of claim **16**, wherein the plurality of structural members comprises at least one pipe.

28. The bollard structure of claim **16**, wherein the plurality of structural members comprises at least one angle.

29. The bollard structure of claim **16**, wherein the plurality of structural members comprises at least one channel.

30. The bollard structure of claim **16**, wherein the plurality of structural members comprises at least one plate.

31. The bollard structure of claim **16**, wherein the plurality of structural members comprise structural steel members.

32. The bollard structure of claim **16**, comprising a rebar grillage comprising intersecting and tied together rebar members extending coextensively with at least a portion of the base that includes a structural member to which a bollard is secured.

33. A bollard structure comprising:

a plurality of bollards; and

a base comprising opposed ends and a plurality of members which intersect and are tied together, for each bollard of the bollard structure at least one first structural member extending from a first of the opposed ends of the base to a second of the opposed ends of the base in a first direction intersecting with the opposed ends, and at least one structural member extending to intersect with the at least one first structural member;

each of the plurality of bollards being secured to at least one of the at least one first structural member and the at least one structural member of the base for the respective bollard and extending upwardly from the base so as to transmit forces applied to the at least one bollard to the base;

at least one of the plurality of members that extend parallel to the ends of the base extending between a structural member to which a first bollard is secured and a structural member to which a second bollard adjacent to the first bollard is secured;

wherein the base is configured to be mounted in a shallow excavation with the plurality of bollards extending above grade of the excavation; and

wherein the at least one first structural member or the at least one structural member or both are configured or tied together to retain within the base supporting media introduced into the base when the base is mounted in the excavation such that the rotation is resisted of a bollard or bollards and the base from an impact against the bollard or bollards.

34. The bollard structure according to claim **33**, wherein the at least one of the plurality of members that extend between a structural member to which a first bollard is secured and a structural member to which a second bollard adjacent to the first bollard is secured comprises a structural member.

35. The bollard structure according to claim **33**, wherein the at least one of the plurality of members that extend between a structural member to which a first bollard is secured and a structural member to which a second bollard adjacent to the first bollard is secured comprises a rebar member.

* * * * *

EXHIBIT B

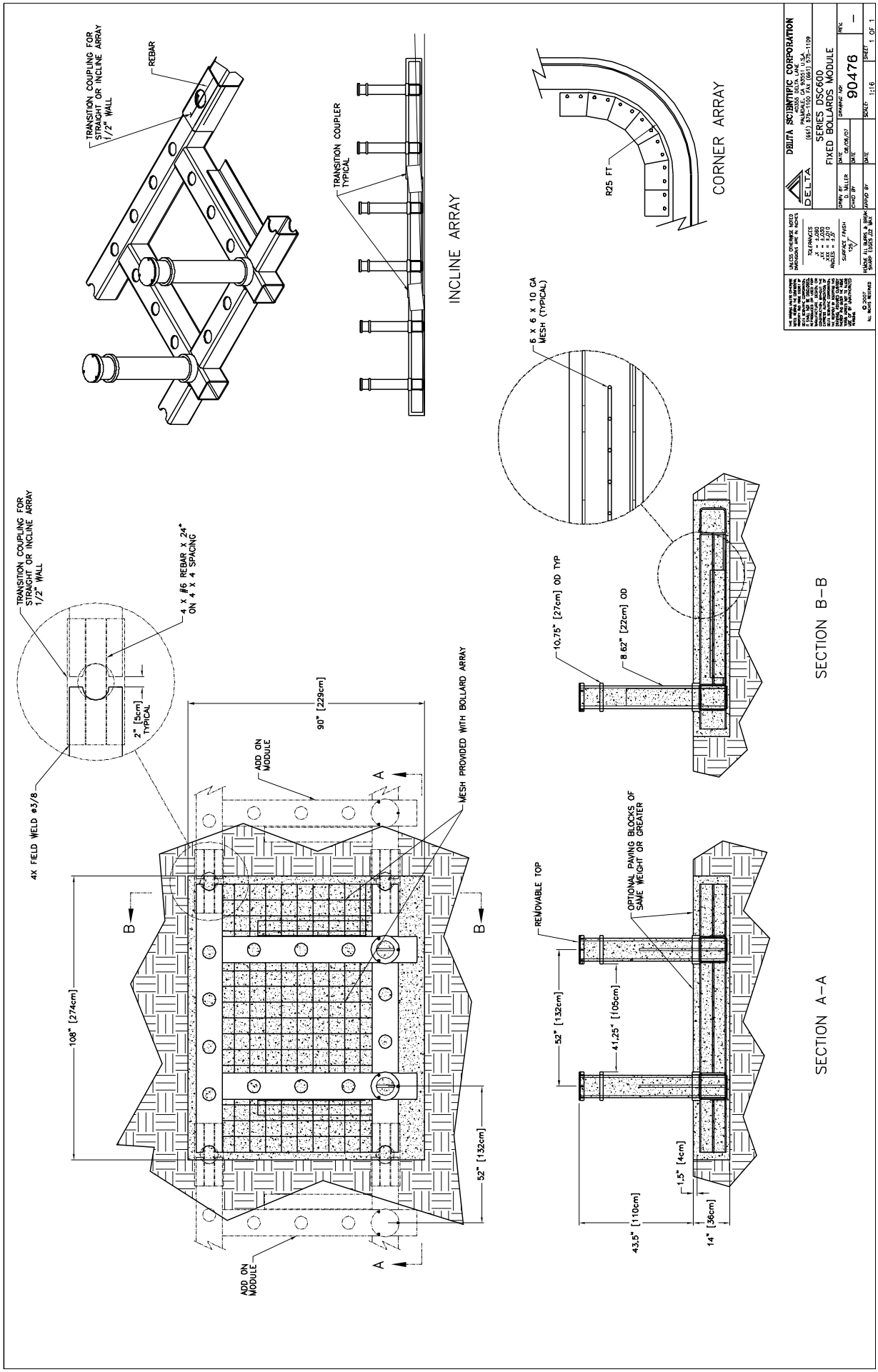

Exhibit B

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EXHIBIT C

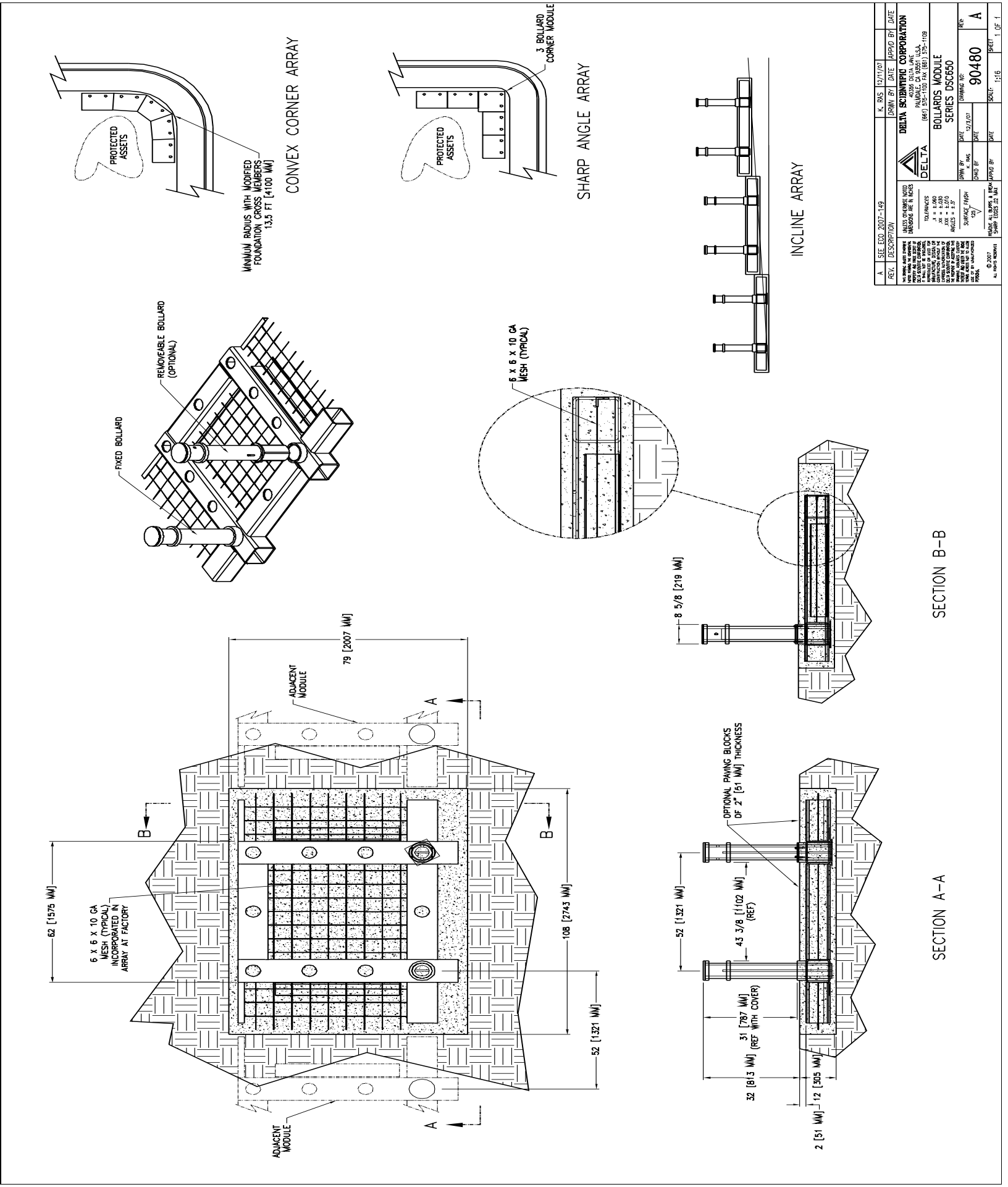
CONVEX CORNER ARRAY
PROTECTED ASSETS
MINIMUM RADIUS WITH MODIFIED FOUNDATION CROSS MEMBERS 13.5 FT [4100 MM]
SHARP ANGLE ARRAY
3 BOLLARD CORNER MODULE
PROTECTED ASSETS
INCLINE ARRAY
REMOVEABLE BOLLARD (OPTIONAL)
FIXED BOLLARD
6 X 6 X 10 GA MESH (TYPICAL)
8 5/8 [219 MM]
SECTION B-B
79 [2007 MM]
ADJACENT MODULE
A
B
62 [1575 MM]
6 X 6 X 10 GA MESH (TYPICAL) INCORPORATED IN ARRAY AT FACTORY
108 [2743 MM]
52 [1321 MM]
ADJACENT MODULE
OPTIONAL PAVING BLOCKS OF 2" [51 MM] THICKNESS
52 [1321 MM]
43 3/8 [1102 MM] (REF)
31 [787 MM] (REF WITH COVER)
32 [813 MM]
12 [305 MM]
2 [51 MM]
SECTION A-A
DELTA SCIENTIFIC CORPORATION
BOLLARDS MODULE
SERIES DSC650
90480
A
1 OF 1

EXHIBIT D

DELTA SCIENTIFIC CORPORATION
PALMDALE, CALIFORNIA 93551-U.S.A.
WWW.DELTASCIENTIFIC.COM

MODEL DSC600
DUAL BOLLARD MODULE
CRASH TESTED – CRASH CERTIFIED

SYNOPSIS

- The DSC600 module is designed to function as a stand alone module or as part of an extended array. Adjacent modules need not be linked; facilitating curved or inclined layouts.
- The foundation is 14.0 inches (356mm) deep and can be set into existing roadways, sidewalks or landscaped areas.
- The exposed surface of the foundation can be textured, colored or finished with paving treads to a depth of 2.0 inches (51 mm).
- The DSC600 has received the highest crash rating under the performance standards of the United States Department of State specification SD-STD-02-.01-Rev. A, March 2003 - K12.
- The rating was assigned following full scale testing by an independent test laboratory. The DSC600 was hit by a 15,006 pound (GVW) (6.807 kg) truck traveling 50.78 mph (81.7 kph) The permanent penetration of the truck bed was 15.0 inches (381 mm).
- The DSC600 has further been certified by the Unites States Department of State to have met their requirement of Dynamic Penetration of less than 1.0 m.
- The DSC600 is supplied from the factory with steel reinforcing mesh welded in place, matching the as tested configuration. In most situations no additional rebar is needed for installation. .
- Decorative slip on cast aluminum and fiberglass covers, both standard and custom are available.

1.0 CONFIGURATION

The DSC600 is a shallow foundation fixed Bollard Module. Consisting of a structural steel skeleton incorporating two Bollards.

1.2 Bollards shall extend above foundation and paving 43.0 inches (1092mm).

1.3 Bollard maximum diameter shall be 10.75 inches (273 mm) (at top rings).

1.4 SPACING. Clear opening between Bollards shall be 41.25 inches (1047 mm) and meets provision of ADA handicap accessibility.

1.5 Finish. Exposed barrier surfaces shall be painted with a gloss white, two-part epoxy high weather resistant paint (or optional galvanized finish).

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2.0 FOUNDATION.

2.1 Footprint. 108 inches (2.74 m) wide (line of array) X 90 inches (2.29 m).

2.2 Depth. 14 inches (36 cm).

2.3 Concrete Reinforcement. Modules shall be furnished with steel reinforcing mesh welded in place. Steel mesh shall match the configuration of the original tested and certified module.

3.0 ARRAYS.

3.1 INCLINED ARRAYS. Modules shall be configured so that they can be arrayed to follow the elevation of sidewalks, roadways or landscaping.

3.2 CIRCLES OR CURVES.

3.2.1 CONCAVE CURVE. (Assets and Modules located inside a circle or curve).

3.2.2 Modules shall be manufactured to be arrayed in curves or circles with a minimum radius of 192 inches (4.88 m).

3.2.3 CONVEX CURVE. (Assets and Modules located outside of a circle or curve).

3.2.4 Modules shall be configured so that they can be arrayed in a convex curve.

3.3 CORNERS.

3.3.1 OUTSIDE CORNER–90 Degree. (Assets and Modules placed outside of a box).

3.3.2 INSIDE CORNERS - 90 degree. For 90-degree corners a 3 (three) Bollard Module shall be available. P/N DSC600-3.

4.0 PERFORMANCE

4.1 Qualification Tests. The module shall have been tested in full scale configuration in accordance with the Department of State Certification Standard Test Method for Vehicle Crash Testing of Perimeter Barriers and Gates, SD-STD-02.01, Revision A, March 2003.

4.2 Crash Rating. The module shall have a Department of State certified rating of K12.

4.3 Dynamic and Permanent Penetration. The module shall specifically have been certified to have a dynamic and permanent penetration of less than 1.0 m in the full-scale test (section 4.0).

5.0 QUALITY ASSURANCE PROVISIONS

5.1 Inspection. Upon completion, the Barrier system will be fully inspected in the manufacturer's shop.

5.2 The following checks shall be made:

5.3 Workmanship. The Barrier shall have a neat and workmanlike appearance.

5.4 Dimensions. Principle dimensions shall be checked against drawings and ordering information.

5.5 Finish. Coatings shall be checked against ordering information and shall be workmanlike in appearance.

6.0 PREPARATION FOR SHIPMENT

6.1 The Barrier system shall be crated or mounted on skids as necessary to prevent damage from handling. The shipping container(s) shall be of sufficient structural integrity to enable the assembly to be lifted and transported by overhead crane or forklift without failure.

7.0 DISCLAIMER.

7.1 Please note - careful consideration must be devoted to the selection, placement and design of a Bollard Array. Just as in the case of a vehicle directing or perimeter security device or gates that block or define a roadway or drive, care must be taken to ensure that approaching vehicle as well as pedestrians are fully aware of the Array. Proper illumination and clearly worded warning signs should be considered. Delta has information available on auxiliary safety equipment not specifically listed herein. It is strongly recommended that an architect and or a traffic and or safety engineer be consulted prior to installation of Bollard Array. Delta will offer all possible assistance in specifying the, equipment, signs and lighting devices but we are not qualified nor do we purport to offer either traffic or safety engineering information.

8.0 PROCUREMENT SOURCE. The Model DSC600 shall be purchased from:

DELTA SCIENTIFIC CORPORATION
40355 Delta Lane
Palmdale, California, 93551, USA
Phone (661) 575-1100
Email info@Deltascientific.com
www.deltascientific.com

EXHIBIT E

DELTA SCIENTIFIC CORPORATION
PALMDALE, CALIFORNIA 93551-U.S.A.
WWW.DELTASCIENTIFIC.COM

MODEL DSC650
DUAL BOLLARD MODULE
OPTIONAL LIFT OUT
CRASH TESTED – CRASH CERTIFIED

SYNOPSIS

- The DSC650 module is designed to function as a stand-alone module or as part of an extended array. Adjacent modules need not be linked; facilitating curved or inclined layouts.
- The foundation is 12 inches (31 cm) deep and can be set into existing roadways, sidewalks or landscaped areas.
- Optionally one or both above grade Bollard tubes may be configured for **manual lift** out, P/N DSC650-300.
- The exposed surface of the foundation can be textured, colored or finished with paving treads to a depth of 2.0 inches (51 mm).
- The DSC650 was tested in accordance ASTM Designation F 2656 – 07 *Standard Test Method for Vehicle Crash Testing of Perimeter Barriers, August 1, 2007* with a rating of PU50/P1. The rating was assigned following full scale testing by an independent test laboratory. The DSC650 was hit by a 5,070 pound (GVW) (2300kg) truck traveling 50 mph (80 kph).
- Certified Dynamic and Final Penetration less than 1.0 m
- The DSC650 is supplied from the factory with steel reinforcing mesh welded in place, matching the as tested configuration. In most situations no additional rebar is needed for installation.
- Decorative slip on cast aluminum and fiberglass covers (P/N DSC650'CAA'), both standard and custom are available.

* Customer Specified

DELTA SCIENTIFIC CORPORATION
PALMDALE, CALIFORNIA 93551-U.S.A.
WWW.DELTASCIENTIFIC.COM

- 1.0 CONFIGURATION. The DSC650 is a shallow foundation fixed Bollard Module. Consisting of a structural steel skeleton incorporating two Bollards.

1.1 Bollards shall extend above foundation and paving 32.0 inches (81 cm m).

1.2 Bollard maximum diameter shall be 8.65 inches (22 cm) (at top rings).

1.3 Spacing. Clear opening between Bollards shall be 43 inches (1.09 m) and meets provision of ADA handicap accessibility.

1.4 Finish. Exposed barrier surfaces shall be painted with a gloss white, two-part epoxy high weather resistant paint (or optional galvanized finish).

2.0 FOUNDATION.

2.1 Footprint.108 inches (2.74 m) wide (line of array) X 73 inches (1.85 m).

2.2 Depth. 12 inches (31 cm).

2.3 Concrete Reinforcement. Modules shall be furnished with steel reinforcing mesh welded in place. Steel mesh shall match the configuration of the original tested and certified module.

3.0 ARRAYS.

3.1 INCLINED ARRAYS. Modules shall be configured so that they can be arrayed to follow the elevation of sidewalks, roadways or landscaping.

3.2 CIRCLES OR CURVES.

3.2.1 CONCAVE CURVE. (Assets and Modules located inside a circle or curve).

3.2.2 Modules shall be manufactured to be arrayed in concave curves or circles with a minimum radius of 159 inches (4.03 m).

3.2.3 CONVEX CURVE. (Assets and Modules located outside of a circle or curve).

3.2.4 Modules shall be configured so that they can be arrayed in a convex curve.

* Customer Specified

3.3 CORNERS.

3.3.1 OUTSIDE CORNER–90 Degree. (Assets and Modules placed outside of a box). P/N DSC650-200

3.3.2 INSIDE CORNERS - 90 degree. For 90-degree corners a 3 (three) Bollard Module shall be available. P/N DSC650-100

4.0 PERFORMANCE.

4.1 Qualification Tests. The module shall have been tested in full scale configuration in accordance with ASTM Designation F 2656 – 07, *Standard Test Method for Vehicle Crash Testing of Perimeter Barriers, August 1, 2007*.

4.2 Crash Rating. The module shall have a certified rating of PU50/ P1

4.3 Dynamic and Permanent Penetration. The module shall specifically have been certified to have a dynamic and permanent penetration of less than 1.0 m in the full-scale test (section 4.1).

5.0 QUALITY ASSURANCE PROVISIONS.

5.1 Inspection. Upon completion, the Barrier system will be fully inspected in the manufacturer's shop. The following checks shall be made:

5.2 Workmanship. The Barrier shall have a neat and workmanlike appearance.

5.3 Dimensions. Principle dimensions shall be checked against drawings and ordering information.

5.4 Finish. Coatings shall be checked against ordering information and shall be workmanlike in appearance.

6.0 PREPARATION FOR SHIPMENT

6.1 The Barrier system shall be crated or mounted on skids as necessary to prevent damage from handling. The shipping container(s) shall be of sufficient structural integrity to enable the assembly to be lifted and transported by overhead crane or forklift without failure.

* Customer Specified

7.0 DISCLAIMER.

7.1 Please note - careful consideration must be devoted to the selection, placement and design of a Bollard Array. Just as in the case of a vehicle directing or perimeter security device or gates that block or define a roadway or drive, care must be taken to ensure that approaching vehicle as well as pedestrians are fully aware of the Array. Proper illumination and clearly worded warning signs should be considered. Delta has information available on auxiliary safety equipment not specifically listed herein. It is strongly recommended that an architect and or a traffic and or safety engineer be consulted prior to installation of Bollard Array. Delta will offer all possible assistance in specifying the, equipment, signs and lighting devices but we are not qualified nor do we purport to offer either traffic or safety engineering information.

8.0 PROCUREMENT SOURCE. The Model DSC650 shall be purchased from:

DELTA SCIENTIFIC CORPORATION
40355 Delta Lane
Palmdale, California, 93551, USA
Phone (661) 575-1100
Email info@Deltascientific.com
www.deltascientific.com

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