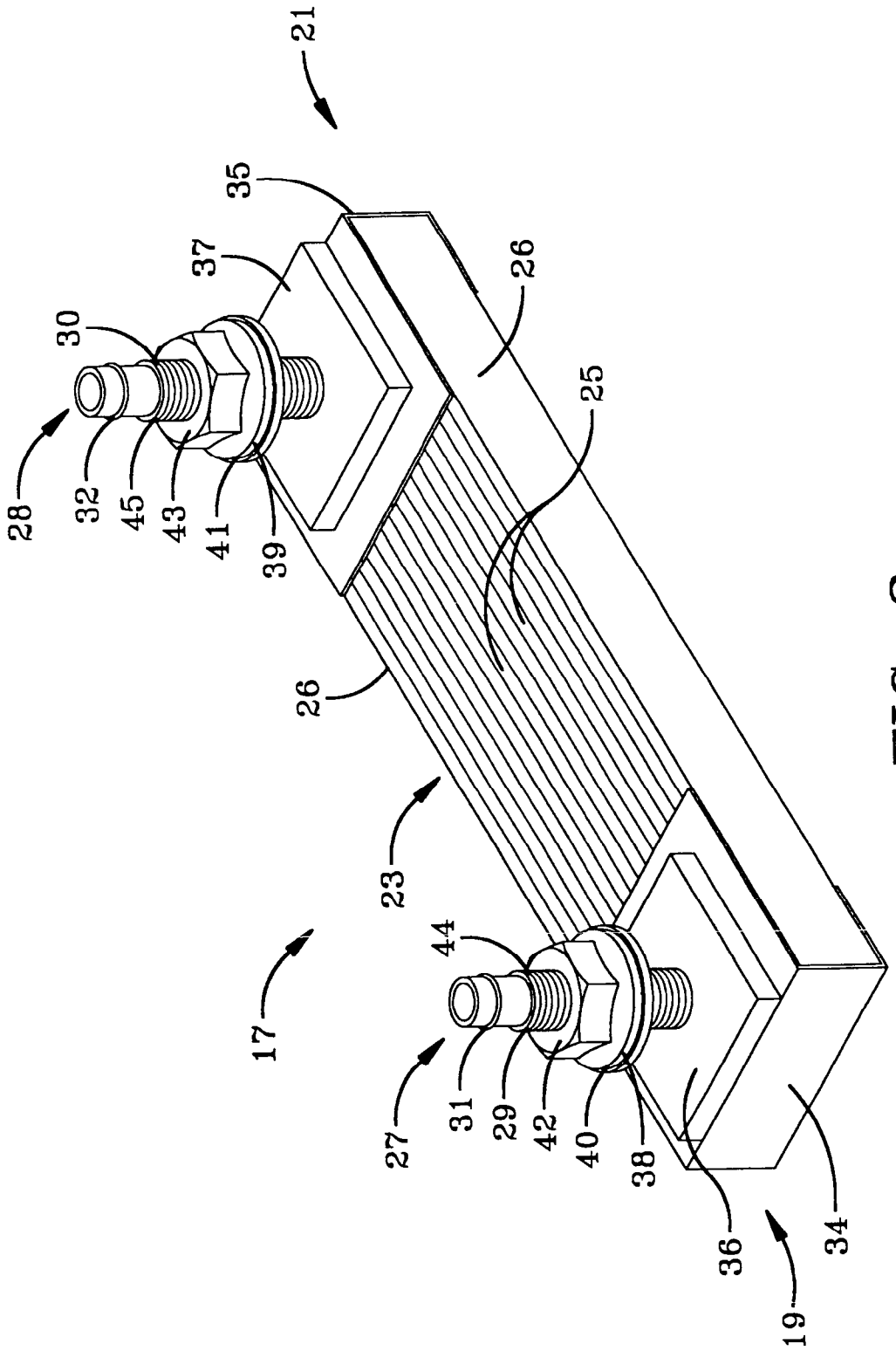
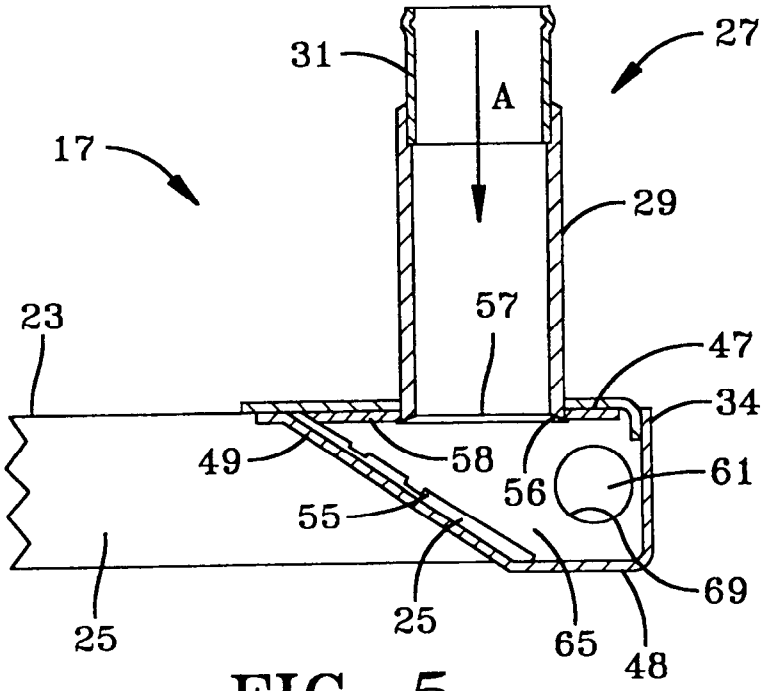
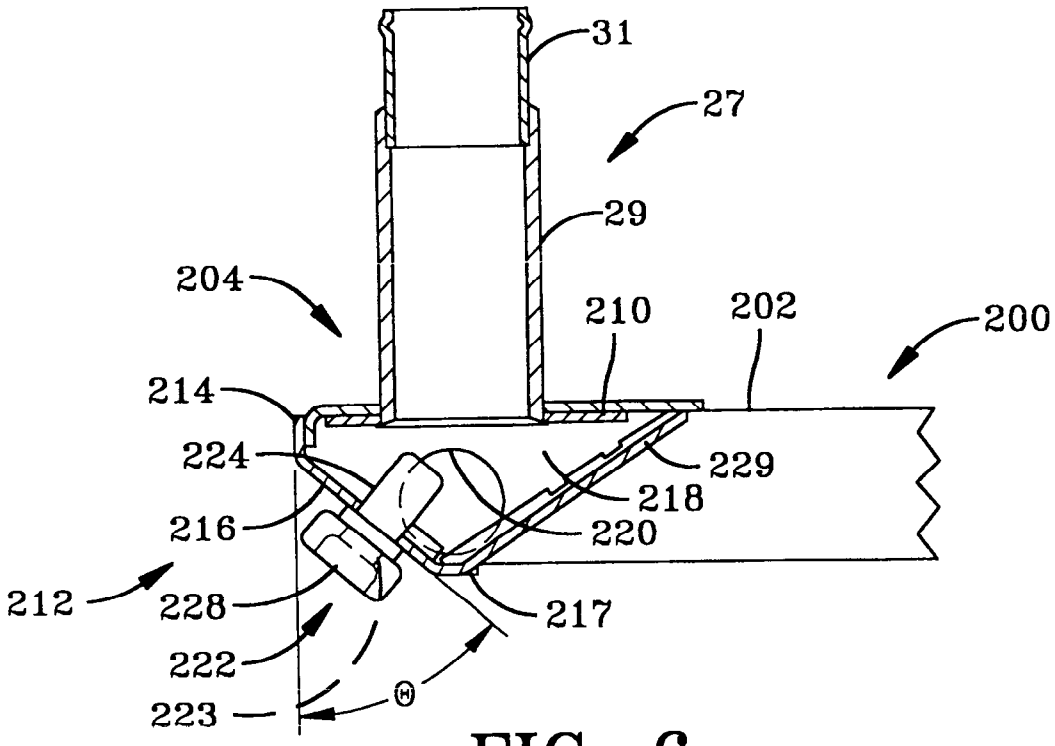

21
35
37
30
26
25
28
32
45
43
41
39
26
23
44
17
27
31
29
42
40
38
36
34
19

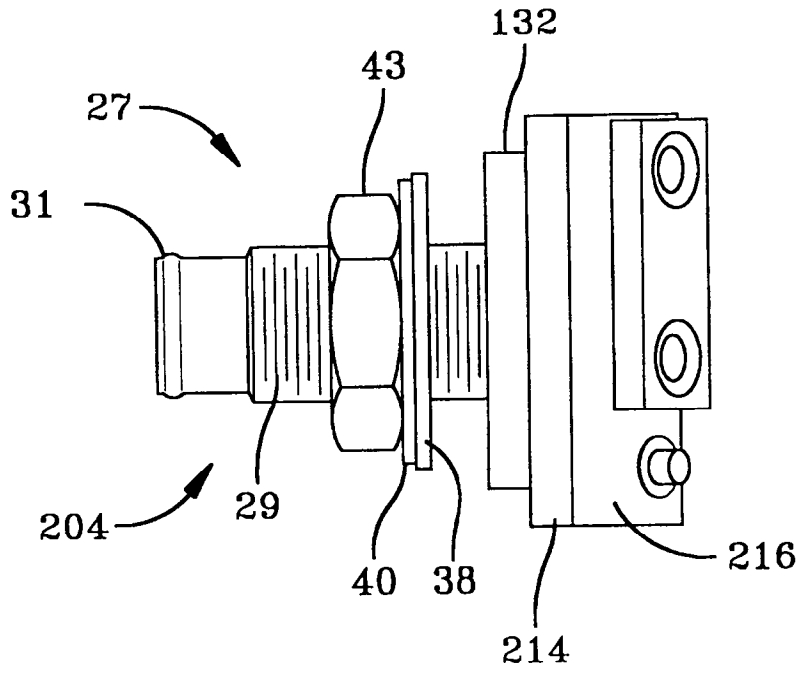
FIG-3



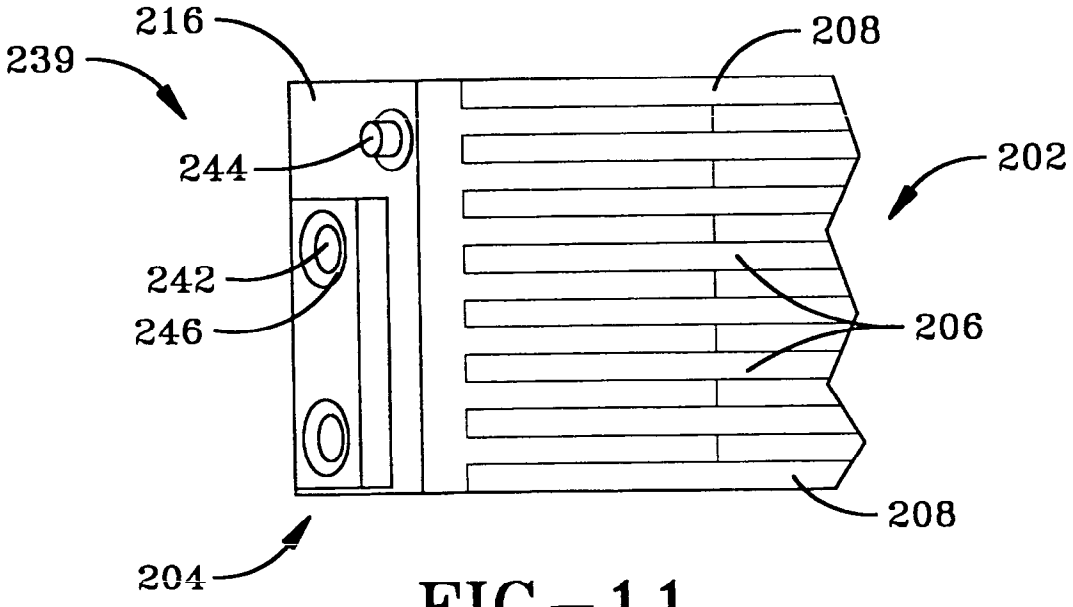
FIG–5
PRIOR ART



FIG–6


132
43
27
31
204
29
40
38
214
216

FIG–10


216
239
208
244
202
242
246
206
208
204

FIG–11

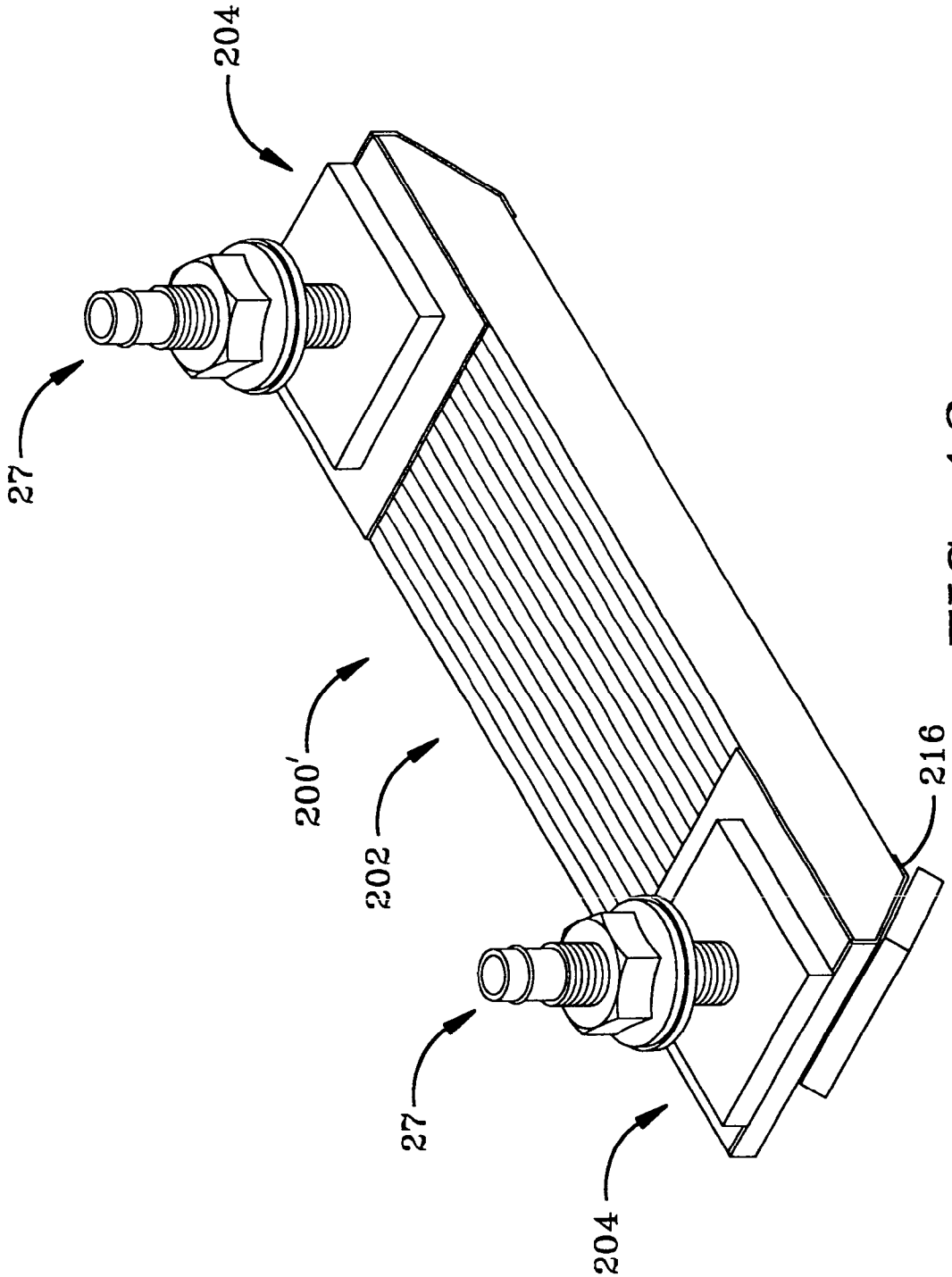


FIG-13

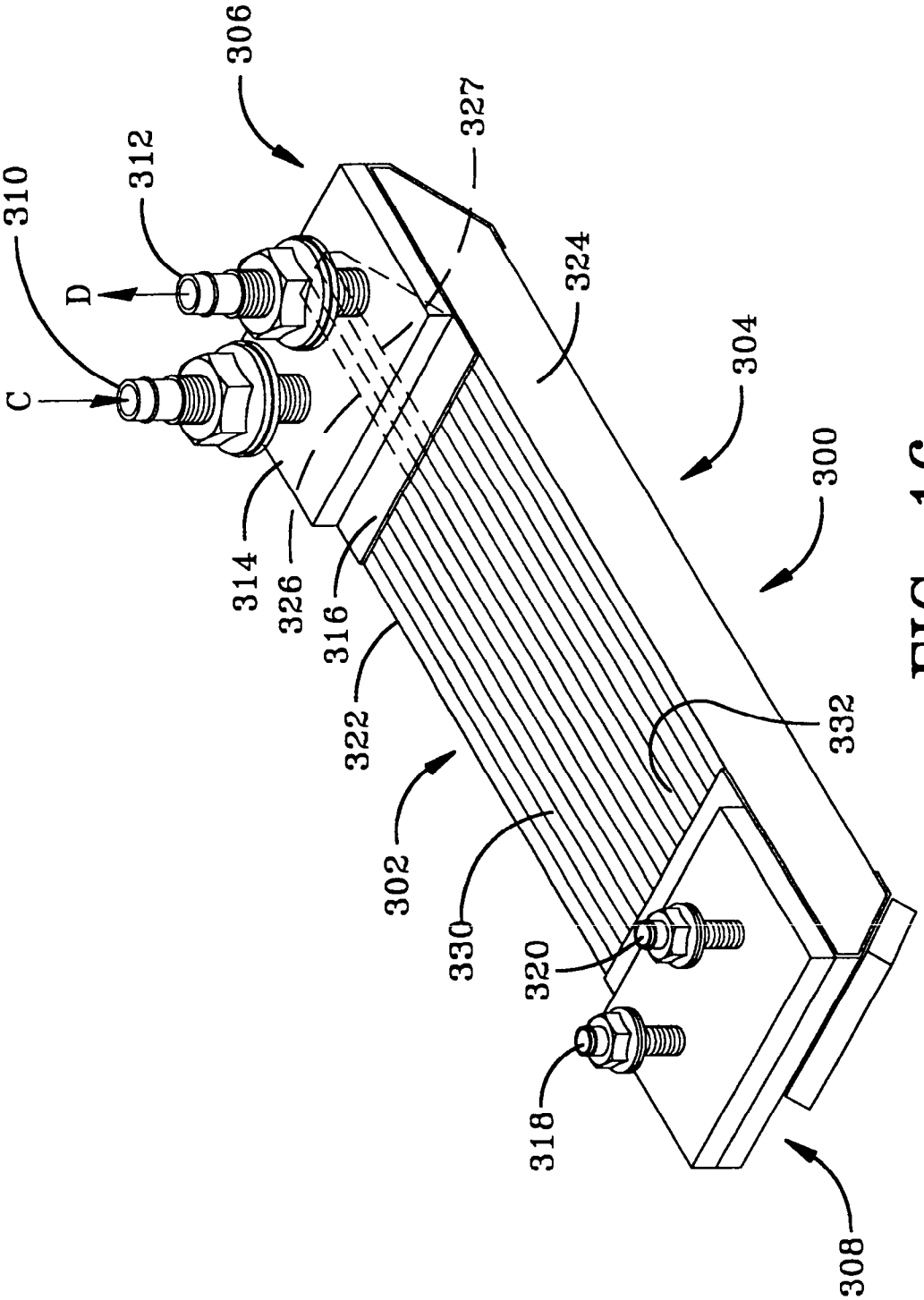

306
327
312
310
D
C
324
304
300
314
326
316
322
332
302
330
320
318
308

FIG-16

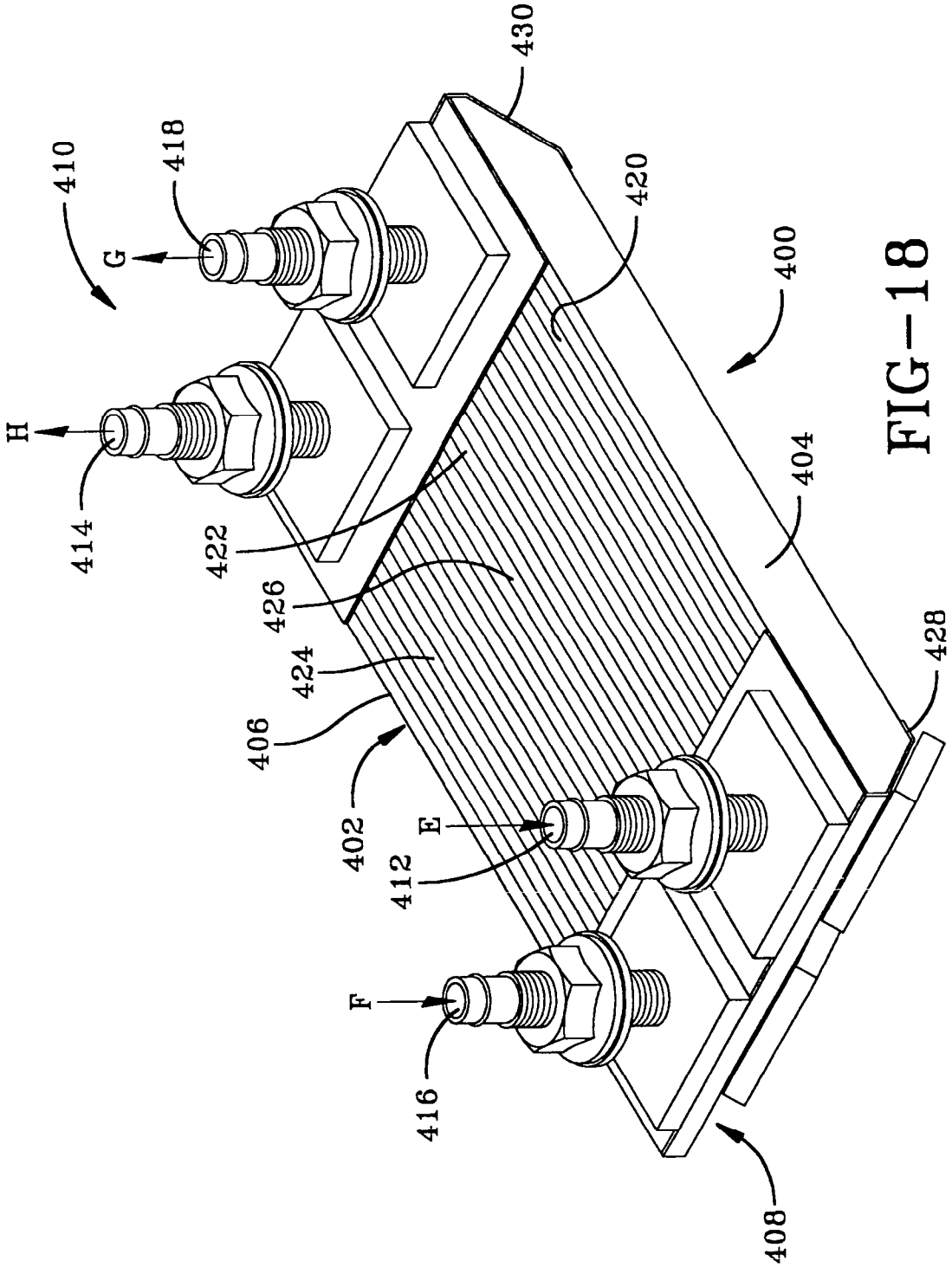

430
410
418
420
G
400
H
414
422
404
426
424
406
428
402
E
412
F
416
408

FIG-18

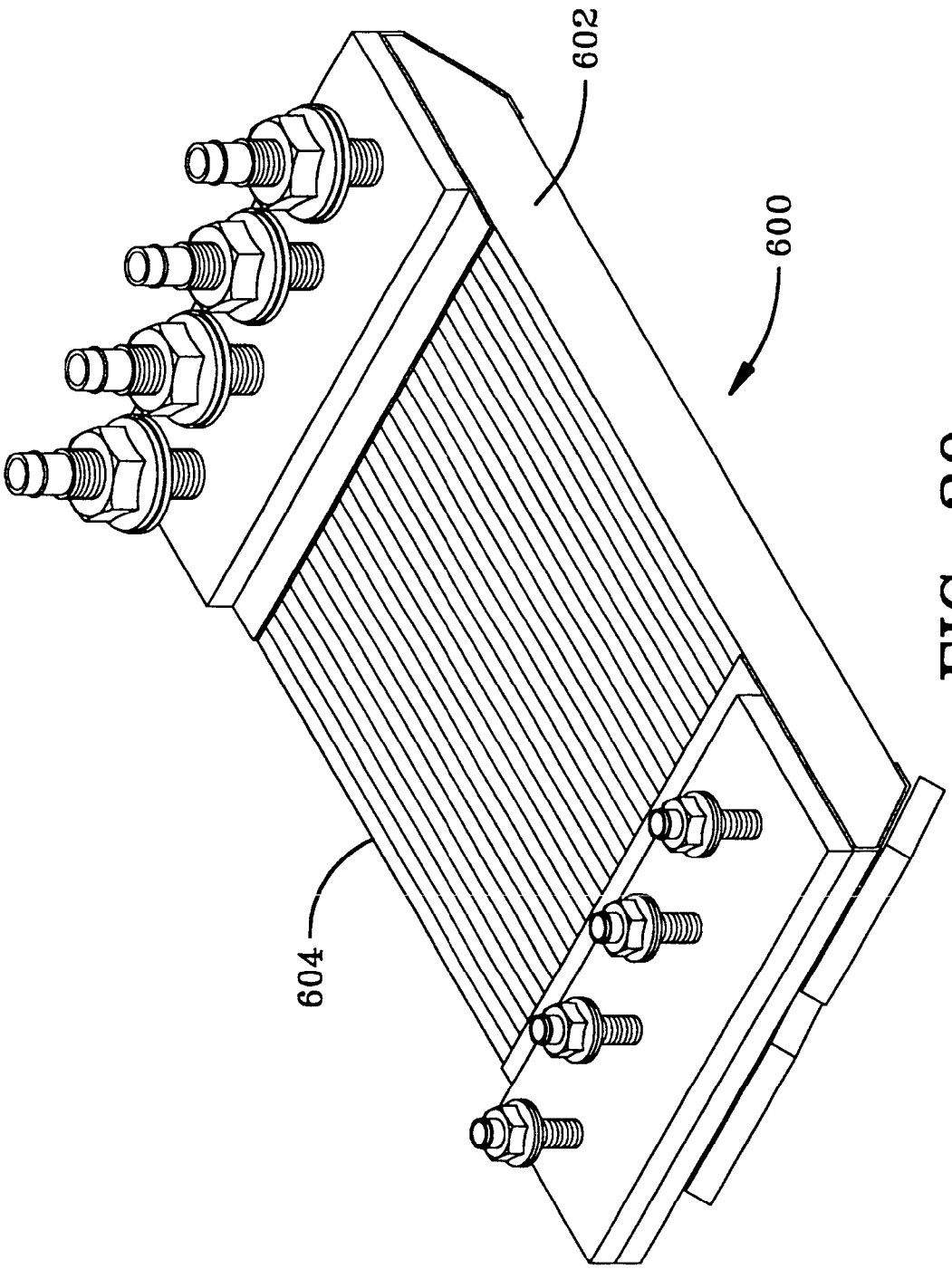


FIG-20

gular tubes, orifices, most often circular in shape, are cut through the inner wall of each of the outer tubes for passing coolant into and out of the outer tubes. The inlet/outlet orifices of the exterior tubes are presently disposed centrally in a vertical direction and endwardly of the respective headers of the keel coolers. However, an analysis of the flow of coolant through the foregoing keel cooler shows that there is a larger amount of coolant per tube flowing through the more central tubes, and much less coolant per tube through the outermost tubes. A graph of the flow through the tubes has a general bell-shaped configuration, with the amount of flow decreasing from the central portion of the tube array. The result is that heat transfer is lower for the outermost tubes, and the overall heat transfer for the keel cooler is also relatively lower, and therefore, the pressure drop across the keel cooler is higher than desired.

The flow of coolant through the respective orifices into the outermost rectangular tubes was found to be inefficient, causing insufficient heat transfer in the outermost tubes. It was found that this occurred because the orifices were located higher and further towards the ends of the respective headers than is required for optimal flow. It has been found by the inventors that enlarging the orifice size and moving it closer to the natural flow path of the coolant flowing through the headers, i.e. its optimal path of flow, coupled with the modification to the design of the header as discussed below, further increased the flow to the outer tubes and made the flow through all of the tubes more uniform, reducing the pressure drop across the cooler while increasing the heat transfer.

The current keel cooler with rectangular heat conduction tubes has an anode and a drain plug or plugs located on the bottom portion of the respective headers, which increases the overall height of the header and which may render these devices subject to potential damage from debris in the water and underwater structures. In order to reduce the likelihood of damage, shrouds have been provided to protect the keel coolers against damage. In addition, the anode(s), and the drain plug(s), by projecting into the ambient water, impede the relative flow of the ambient water as the vessel moves therethrough which increases drag. As explained below, the location of the anode(s) and drain plug(s) so as to minimize the increase height of the header and the keel cooler, reduces the foregoing problems.

As discussed below, the beveled header, and the relocation of the anode assemblies and drain plugs, also contribute to the increase of the overall heat transfer efficiency of the keel cooler according to the invention, since the ambient water is caused to flow towards and between the respective heat conduction tubes, rendering the heat transfer substantially higher than in the keel cooler presently being used. This increase in heat transfer is due at least in part to the increase in turbulence in the flow of ambient water across the forward header and along and between the coolant flow tubes.

One of the important aspects of keel coolers for vessels is the requirement that they take up as small an area on the vessel as possible, while fulfilling or exceeding their heat exchange requirement with minimized pressure drops in coolant flow. The area on the vessel hull which is used to accommodate a keel cooler is referred to in the art as the footprint. In general, keel coolers with the smallest footprint and least internal pressure drops are desirable. One of the reasons that the keel cooler described above with the rectangular heat conduction tubes has become so popular, is because of the small footprint it requires when compared with other keel coolers. However, keel coolers according to the design of rectangular tubed keel coolers presently being used have been found by the present inventors to be larger than necessary both in terms of size and the related internal pressure drop. By the incorporation of the various aspects of the present invention described above (and in further detail below), keel coolers having smaller footprints and lower internal pressure drops are possible. These are major advantages of the present invention.

Some of the shortcomings of heat exchangers with rectangular heat conduction tubes presently being used relate to the imbalance in the coolant flow among the parallel tubes, in particular in keel coolers which lead to both excessive pressure drops and inferior heat transfer which can be improved according to the present invention. The unequal distribution of coolant flow through the heat conduction tubes in present rectangular tube systems has led to inferior heat transfer in the systems. In order to attend to this inferior heat transfer, the designers of the present keel coolers on the market have been compelled to enlarge or oversize the keel cooler which also may increase the footprint, through additional tube surface area, to overcome the poor coolant distribution and inferior heat transfer in the system. This has resulted in the present one piece keel coolers which are unnecessarily oversized when compared with the invention described below. In some instances, the invention described below would result in fewer keel coolers in cooling circuits which require multiple keel coolers.

The unequal distribution of coolant flow through the heat conduction tubes in present rectangular tube systems also results in higher internal pressure drops in the systems. This higher pressure drop is another reason that the prior art requires oversized heat exchangers. Excessive oversizing compensates for poor heat transfer efficiency and excessive pressure drops, but this requires added costs and a larger footprint.

When multiple pass (usually two pass) keel coolers are specified for the present state of the art, an even greater differential size is required when compared with the present invention, as described below.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a heat exchanger for fluid cooled heat sources which is smaller than corresponding heat exchangers having the same heat exchange capability.

Another object of the present invention is to provide an improved heat exchanger for industrial applications which is more efficient than heat exchangers presently known and used.

It is yet another object of the present invention to provide an improved one-piece heat exchanger for vessels which is more efficient in heat transfer than presently known one-piece heat exchangers.

It is an additional object to produce a one-piece heat exchanger and headers thereof which generally equalizes the flow of coolant through each of the tubes of the keel cooler.

A further object is to provide an improved one-piece heat exchanger which reduces the pressure drop of coolant flowing therethrough.

A further object of the present invention is to provide an improved one-piece heat exchanger having heat conduction tubes which are rectangular in cross-section having a length which is reduced in size from the current heat exchangers due to improved coolant flow distribution inside the heat exchanger and enhanced ambient water flow across the keel cooler.

of coolant between the header and the outermost coolant flow tube, according to an aspect of the invention;

FIG. **16** is a pictorial view of a two pass keel cooler system according to the invention;

FIG. **17** is a cut away view of a portion of the header shown in FIG. **16**;

FIG. **18** is a pictorial view of a multiple systems combined, having two single pass portions, according to the invention;

FIG. **19** is a pictorial view of a keel cooler according to the invention, having a single pass portion and a double pass portion; and

FIG. **20** is pictorial view of two double pass systems according to the invention;

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The fundamental components of a heat exchanger system for a water going vessel are shown in FIG. **1**. The system includes a heat source **1**, a heat exchanger **3**, a pipe **5** for conveying the hot coolant from heat source **1** to heat exchanger **3**, and a pipe **7** for conveying cooled coolant from heat exchanger **3** to heat source **1**. Heat source **1** could be an engine, a generator or other heat source for the vessel. Heat exchanger **3** could be a one-piece keel cooler (since only one-piece keel coolers are discussed herein, they are generally only referred to herein as "keel coolers.") Heat exchanger **3** is located in the ambient water, below the water line (i.e. below the aerated water line), and heat from the hot coolant is transferred through the walls of heat exchanger **3** and expelled into the cooler ambient water.

FIG. **2** shows a heat exchanger **11** mounted on a vessel, for transferring heat from the coolant flowing from an engine or other heat source **13** to the ambient water. Coolant flows from one of lines **14** or **15** from engine **13** to keel cooler **11**, and back through the other flow pipe from keel cooler **11** to engine **13**. Keel cooler **11** is attached to, but spaced from the hull of vessel.

A keel cooler **17** according to the prior art is shown in FIG. **3**. It includes a pair of headers **19**, **21** at opposite ends of a set of parallel, rectangular heat conductor tubes **23**, having interior tubes **25** and two exterior tubes (discussed below). A pair of nozzles **27**, **28** conduct coolant into and out of keel cooler **17**. Nozzles **27**, **28** have cylindrical threaded connectors **29**, **30**, and nipples **31**, **32** at the ends of the nozzles. Headers **19**, **21** have a generally prismatic construction, and their ends **34**, **35** are perpendicular to the parallel planes in which the upper and lower surfaces of tubes **23** are located. Keel cooler **17** is connected to the hull of a vessel through which nozzles **27** and **28** extend. Large gaskets **36**, **37** each have one side against headers **19**, **21** respectively, and the other side engages the hull of the vessel. Rubber washers **38**, **39** are disposed on the inside of the hull when keel cooler **17** is installed on a vessel, and metal washers **40**, **41** sit on rubber washers **38**, **39**. Nuts **42**, **43**, which typically are made from metal compatible with the nozzle, screw down on sets of threads **44**, **45** on connectors **29**, **30** to tighten the gaskets and rubber washers against the hull to hold keel cooler **17** in place and seal the hull penetrations from leaks

Turning to FIG. **4**, a partial, cross section of the current keel cooler according to the prior art and depicted in FIG. **3**, is shown. Keel cooler **17** is composed of the set of parallel heat conduction or coolant flow tubes **23** and the header or manifold **19**. Nozzle **27** is connected to header **19** as described below. Nozzle **27** has nipple **31**, and connector **29** has threads **44** as described above, as well as washer **40** and nut **42**. Nipple **31** of nozzle **27** is normally brazed or welded inside of a connector **29** which extends inside the hull. Header **19** has an upper wall or roof **47**, outer back wall **34**, and a bottom wall or floor **48**. Header **19** includes a series of fingers **52** which are inclined with respect to tubes **23**, and define spaces to receive ends **55** of interior tubes **25**.

Referring also to FIG. **5**, which shows keel cooler **17** and header **19** in cross section, header **19** further includes an inclined surface or wall **49** composed of fingers **52**. End portions **55** of interior tubes **25** extend through surface **49**. Interior tubes **25** are brazed or welded to fingers **52** to form a continuous surface. A flange **56** surrounds an inside orifice **57** through which nozzle **27** extends and is provided for helping support nozzle **27** in a perpendicular position on the header **19**. Flange **56** engages a reinforcement plate **58** on the underside of wall **47**.

In the discussion above and to follow, the terms "upper", "inner", "downward", "end" etc. refer to the heat exchanger, keel cooler or header as viewed in a horizontal position as shown in FIG. **5**. This is done realizing that these units, such as when used on water going vessels, can be mounted on the side of the vessel, or inclined on the fore or aft end of the hull, or various other positions.

Each exterior side wall of header **19** is comprised of an exterior or outer rectangular tube, one of which is indicated by numeral **60** in FIG. **4**. The outer tubes extend into header **19**. FIGS. **4** and **5** show both sides of outside tube wall **61**. Both sides of interior wall **65** are shown in FIGS. **4** and **5**. A circular orifice **69** is shown extending through interior wall **65** of the outside rectangular tube of keel cooler **17**, and is provided for carrying coolant flowing through the outside tube into or out of header **19**. In this regard, nozzle **27** can either be an inlet conduit for receiving hot coolant from the engine whose flow is indicated by the arrow A in FIG. **5**, but also could be an outlet conduit for receiving cooled coolant from header **19** for circulation back to the heat source. It is important to note that in the prior art, the location and size of orifice **69** limits the amount of flow which can pass through orifice **69**. More particularly, the orifice has heretofore been mounted too high, is too small, and too far away from the natural flow path of the coolant, resulting in reduced flow through the outer rectangular tubes, non-uniform coolant flow through tubes **23**, and a disadvantageously high pressure drop as the coolant flows through the orifices, and at higher rates through the less restricted inner tubes—even though the outermost tubes have the greatest ability to transfer heat.

FIG. **4** also shows that keel cooler header **19** has a drainage orifice **71** for receiving a correspondingly threaded and removable plug. The contents of keel cooler **17** can be removed through orifice **71**.

Orifice **57** is separated by a fairly large distance from the location of orifice **69**, resulting in a reduced amount of flow through each orifice **69**, the reduction in flow being largely due to the absence of the orifice in the natural flow path of the coolant. Although this problem has existed for five decades, it was only when the inventors of the present invention were able to analyze the full, flow characteristics that they verified the importance of properly locating and sizing the orifice. In addition, the configuration of the header in both single pass and multiple pass systems affects the flow through the header as discussed below.

Still referring to the prior art header **19** shown in FIGS. **3–5**, it can be seen that outer back wall **34** and floor **48** are

expected to be even greater for two pass systems. Also, as discussed later, the deficiencies of the prior art for higher coolant flows, are not experienced to the same extent by the keel cooler according to the invention.

The angle of beveled wall **216** is an important part of the present invention. As discussed herein, the angle, designated as θ (theta), is appropriately measured from the plane perpendicular to the longitudinal direction of coolant flow tubes **202** and located at the part of the closed end portion of header **204** spaced furthest from the set of open ends or ports **227** of tubes **206**, i.e. from end wall **214**, to beveled wall **216**. Angle θ is described as an exterior angle, since it is exterior to end wall **214** and beveled bottom wall **216**; it is measured from a plane perpendicular to the longitudinal axes of the flow tubes **202** and roof **210**, and it is along end wall **214** at the beginning of beveled bottom wall **216**. The factors for determining angle θ are to maintain the center to center distance of the nozzle spacing, to maintain the overall length of the keel cooler, to provide vertical drop beneath the roof of the header so that the header can hold the anode insert, to keep the anode assembly from extending longitudinally beyond wall **214**, and to allow for the maximum length of heat transfer tubing (and the associated reduction of the length of the header). Angle θ could be affected by the size of orifice **220**, but generally the other factors limit angle θ before the orifice would affect it.

Another important aspect to beveled wall **216** is the manner in which it directs the flow of ambient water over and between the exterior walls of coolant flow tubes **202**, to increase the heat transfer between the coolant inside the tubes and the outside ambient water. It will be recalled that under the prior art as shown in FIGS. **3–5**, vertical wall **34** diverted the ambient water as the vessel passed therethrough, so that the ambient water to a significant extent went around rather than between and over the separated rectangular tubes **27**.

It is desirable not to increase the depth of a keel cooler any more than necessary, to make it less likely to strike debris in the water, and less likely to strike underwater objects or the ground beneath the vessel, i.e. the bottom. For this reason, anode assembly **222** is preferably mounted on beveled wall **216**. As shown in FIGS. **6** and **11**, anode bar **228** of anode assembly **222** is attached to beveled wall **216**, by anode screws **242** which extend through lockwashers **246** and into anode insert **224**. Anode insert **224** extends from wall **216** into header **204**. This decreases the depth of anode assembly according to the prior art, under which anode assembly **222** would have extended from lower wall **217**.

As shown most clearly in FIGS. **10** and **11**, drain plug **244** is also preferably located on beveled wall **216** to avoid plug **244** from striking debris in the water or hitting bottom. More importantly, the drain plug and anode located on the beveled surface have less interference with the ambient water flow pattern (FIG. **12**, arrows B). Drain plug **244** extends into a drain plug insert which is part of the header. Under the prior art, drain plug **244** would otherwise have extended from lower wall **217**.

Referring to FIG. **12**, which shows a side view of keel cooler **200**, arrows B show the flow pattern of ambient water across keel cooler **200** as the keel cooler moves to the right through the ambient water. Arrows B show that the water impinges on beveled wall **216**, flows around the beveled wall, and, due to the drop in pressure, along inclined surface **229** and up and between coolant flow tubes **202**. This flow is turbulent which greatly increases the transfer of heat from the heat conduction tubes as compared to the prior art shown in FIGS. **3–5**, yielding a more efficient and effective heat exchanger than those of the prior art. Additionally, having drain plug **244** and anode bar **228** on beveled wall **216** causes less interference with the ambient water flow pattern shown by arrows B. They contribute to the improved heat transfer efficiency.

Keel coolers according to the invention are used as they have been in the prior art, and incorporate two headers which are connected by an array of parallel coolant flow tubes. A common keel cooler according to the invention is shown in FIG. **13**, which illustrates a keel cooler **200'** having opposing headers **204** like the one shown in FIG. **7**. The headers shown have the identical numbers to those shown in FIG. **7**. Heated coolant fluid flows into one nozzle **27** from a heat source in the vessel, then flows through one header **204**, the coolant flow tubes **202**, the other header **204**, the other nozzle **27**, and the cooled coolant flows back to the heat source in the vessel. While flowing through headers **204** and coolant flow tubes **202**, the coolant transfers heat to the ambient water. All of the advantages of the beveled wall **216** apply to keel cooler **200'**.

As mentioned above, the size of orifice **220** is an important part of the new keel cooler and the new header. It is desirable to have the orifice be sufficiently large to not impede the amount of coolant flow to exterior heat conduction tubes **208** of the keel cooler, and to implement a balanced flow near the juncture of beveled wall **216** and the interior of surface **229** and ports **227**. It has been found that a distance of about ⅛ of an inch between orifice **220** and walls adjacent its lower edge (the interior of the lower parts of wall **216**, wall **217** and surface **229**, as shown in FIG. **6**) be provided for manufacturing tolerance as it is fabricated, which is advantageously done by drilling or cutting orifice **220** into wall **218**. It is important that the coolant flow into exterior tubes **208** be near the bottom of walls **218**, rather than closer to their top. The distance between the top of orifice **220** and roof **210** is not as crucial. The proper size and placement of orifice **220** thus reduces the pressure drop of the coolant in the entire system of keel cooler **200**, balances the flow among the multiple tubes, and thus increases the heat transfer through the outer tubes and therefore the entire unit.

While the embodiment under discussion is a beveled keel cooler, the size and location of the orifice to the outermost tubes in a one-piece keel cooler according the prior art as shown in FIGS. **3–5** is significantly improved according to the present invention. FIG. **14** shows a keel cooler header and an outermost coolant flow tube much as was shown in FIG. **5** (and corresponding parts have corresponding numbers), except that orifice **69** has been replaced by orifice **221**. Orifice **221** has been moved closer to the openings of the inner coolant flow tubes, has been moved lower, and its size has been increased significantly, so that it is as large as possible within the area permitted on wall **67**. Relocated and enlarged orifice **221** enables more coolant fluid to flow into the outermost coolant flow tubes (or from it if the flow were to proceed out of nozzle **27**). As explained in the preceding paragraph, the use of orifice **221** reduces the pressure drop of the coolant and balances the flow of coolant amongst the coolant flow tubes, thus increasing heat transfer for the keel cooler (or other heat exchanger).

As a practical matter, it has been found that a circular orifice having a diameter as large as possible while maintaining the orifice in its wall within the header provides the desired coolant flow into the outermost tubes while enabling the proper amount of flow into the inner tubes as well. More than one orifice can also be provided, as shown in FIG. **15**,

19. In FIG. 19, a keel cooler 500 is depicted having a single pass keel cooler portion 502, and a double pass keel cooler portion 504. Keel cooler portion 502 functions as that described with reference to FIGS. 6–11, and keel cooler portion 504 functions as that described with reference to FIGS. 16 and 17. FIG. 19 shows a double pass system for one heat exchanger, and additional double pass systems could be added as well.

FIG. 20, shows a keel cooler 600 having 2 double pass keel cooler portions 602, 604, which can be identical or have different capacities. They each function as described above with respect to FIGS. 16 and 17. Multiple coolers combined is a powerful feature not found in prior one-piece keel coolers. The modification of the special separator/tube design improves heat transfer and flow distribution while minimizing pressure drop concerns.

The keel coolers described above show nozzles for transferring heat transfer fluid into or out of the keel cooler. However, there are other means for transferring fluid into or out of the keel cooler; for example, in flange mounted keel coolers, there are one or more conduits such as pipes extending from the hull and from the keel cooler having end flanges for connection together to establish a heat transfer fluid flow path. Normally a gasket is interposed between the flanges. There may be other means for connecting the keel cooler to the coolant plumbing system in the vessel. This invention is independent of the type of connection used to join the keel cooler to the coolant plumbing system.

The invention has been described with particular reference to the preferred embodiments thereof, but it should be understood that variations and modifications within the spirit and scope of the invention may occur to those skilled in the art to which the invention pertains.

What is claimed is:

1. A header for a heat exchanger, the heat exchanger having a plurality of parallel tubes extending in a longitudinal direction and having generally rectangular cross sections, the tubes including a pair of outermost tubes and at least one inner tube located between the outermost tubes, the outermost tubes having an outside wall and a parallel inside wall, and the inner tubes having coolant ports, said header comprising:

an upper wall having an upper end portion, opposing side portions and an upper inner portion, said upper end portion and said upper inner portion being located in a plane, and an inlet/outlet opening for permitting the flow of coolant between an inlet/outlet and said header, said upper wall having a length extending between said upper end portion and said upper inner portion;

a lower wall located below said upper wall, said lower wall having a lower end portion, opposing side portions and a lower inner portion, said lower wall having a length extending between the lower end portion and the lower inner portion, said length being less than the length of said upper wall and disposed inwardly from both the upper end portion and the upper inner portion of said upper wall;

an end wall extending transversely from the end portion of said upper wall and terminating below said upper wall and above said lower wall;

an inclined surface extending between the inner portions of said lower wall and said upper wall, and including the open end(s) of the at least one inner tube to said header;

outside side walls extending between the side portions of said upper wall and said lower wall, said outside side walls each being an extension of the outside wall of the outermost tube of the heat exchanger;

inside side walls parallel to said outside side walls, said inside side walls each being an extension of the inside wall of the outermost tube; and

a beveled wall extending between the termination of said end wall and the end portion of said lower wall and beveled with respect to said longitudinal direction from said upper wall to said lower wall towards said tube to reduce the turbulence of coolant flow to and/or from said parallel tubes and increase ambient fluid flow to the exterior surfaces of said parallel tubes compared to a non-beveled wall;

the inner surfaces of said inside side walls, upper wall, end wall, bottom wall, beveled wall and inclined surface forming a header chamber;

said inside side walls each having an orifice for permitting the flow of coolant between said header chamber and the respective outermost tube;

said orifice being disposed at least partly over said inclined surface when viewed in a transverse direction with respect to the longitudinal direction and at least partly beneath said inlet/outlet opening.

2. A header according to claim 1 wherein said orifice is a circular orifice.

3. A header according to claim 1 wherein said orifice is a circular orifice generally tangent to said bottom wall.

4. A header according to claim 1 wherein said orifice is a circular orifice whose size is the maximum size that will fit on said inner wall in said header chamber.

5. A header according to claim 1 wherein the parallel tubes have an internal cross sectional area, and wherein said orifice has an area of at least 1½ times the internal cross sectional area of each of the parallel tubes.

6. A header according to claim 5 wherein the area of said orifice is about twice the area of each of the parallel tubes.

7. A header according to claim 1 wherein the side walls having said orifice have an internal cross sectional area, and wherein said orifice has an area of at least 1½ times the internal cross sectional area.

8. A header according to claim 1 wherein said orifice has an area substantially as large as the largest circular orifice which will fit in said side walls at the location of said orifice.

9. A header according to claim 1 wherein said orifice is one of a plurality of orifices.

10. A header according to claim 1 wherein each of said orifices covers substantially the respective inside side walls.

11. A header according to claim 1 and further including an anode assembly located on said beveled wall.

12. A header according to claim 11 wherein said beveled wall has an interior side and an exterior side, and wherein said anode assembly has an anode bar located on the exterior side of said beveled wall, and said anode bar does not extend beyond said end wall.

13. A header according to claim 1 and further including a drain assembly including a drain hole located in said beveled wall, and a drain plug locatable in said drain hole, said drain plug extending outwardly from said beveled wall.

14. A header according to claim 13 wherein said drain plug does not extend below said lower wall.

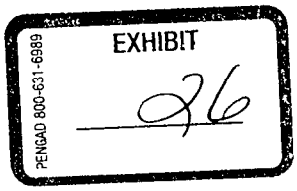
15. A one-piece heat exchanger comprising:

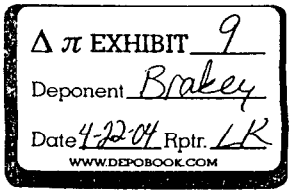
a plurality of coolant flow tubes extending in a longitudinal direction for carrying coolant fluid and for transferring heat from the coolant fluid to a fluid heat sink, said coolant flow tubes having inner tubes and exterior side tubes, said inner tubes having at least one set of open ends in proximity to each other; and

UNITED STATES DISTRICT COURT

EASTERN DISTRICT OF LOUISIANA

EAST PARK RADIATOR	*	CIVIL ACTION
	*	NO. 97-3598 c/w 97-3974
VERSUS		
	*	SECTION "S"
R.W. FERNSTRUM & COMPANY	*	MAG. DIV. "1"





TERM SHEET

This Term Sheet (the "Agreement") is effective as of May 5, 1999, between R.W. Fernstrum & Company, a Michigan corporation, having a principal place of business at Menominee, Michigan (hereinafter "Fernstrum") and East Park Radiator & Battery Shop, Inc., a Louisiana corporation having a principal place of business at Odette Street, Houma, Louisiana; Donovan Marine, Inc., a Louisiana corporation, having its principal place of business at 400 N. Carrollton Avenue, New Orleans, Louisiana, 70119; (sometimes hereinafter referred to collectively as "Donovan, et al")..

PREAMBLE

WHEREAS, there are now pending in the United States District Court for the Eastern District of Louisiana those lawsuits between Donovan, et al and Fernstrum under Civil Action Nos. 97-3974, 97-3598 and 97-3657 (the "litigation");

WHEREAS, Fernstrum and Donovan, et al agreed to settle the above litigation during a conference with United States District Judge Mary Anne Vial Lemmon on May 5, 1999;

WHEREAS, subject to the execution of a mutually acceptable settlement agreement, this Agreement is intended to set forth in principle the terms of that settlement; and

WHEREAS, Duramax, Inc. (hereinafter "Duramax"), an Ohio corporation, having a principal place of business at 16025 Johnson Street, Middlefield, Ohio, does hereby intervene in this Agreement to the extent, and for the purposes set forth below;

CONSIDERATION

NOW, THEREFORE, in consideration of the terms set forth below and with the intention of being legally bound the parties hereby agree as follows:

TERMS

1. The parties agree that all claims and counterclaims asserted in the litigation shall be dismissed with prejudice through the filing of a Stipulated Order of Dismissal in the form attached as Exhibit I.

2. Without restriction, Donovan Marine, East Park and Duramax may sell their existing stock of one-piece keel coolers, and in addition Donovan Marine, East Park and Duramax shall have an additional 90 days to sell and/or manufacture keel coolers to fill existing and new orders received during those 90 days. Donovan Marine and East Park recognize and stipulate that the presently existing stock of one-piece coolers shall consist of those coolers whose respective serial numbers are set forth on written notice thereof provided to counsel for Fernstrum within ten (10) days of date of entry of the Stipulated Order of Dismissal.

3. At the conclusion of the time periods set forth in paragraph 2, Duramax and East Park Radiator agree to modify design of the keel cooler to incorporate beveled fore and aft portions as generally shown on Exhibit 2. However, if Fernstrum in the future no longer only uses a vertical edge at the aft and fore of the headers on its keel cooler, then at such time Donovan et al shall not be required to comply with the first sentence of this section and shall at that time be under no restrictions pursuant to this Agreement.

4. The Agreement is binding on all subsidiaries, affiliates, successors, assigns, and/or related companies controlled by the executing parties, including Progressive Allied Industries, Inc. and shall serve to protect and be for the benefit of all customers and agents of the parties.

5. All parties agree to permanently affix, or permanently imprint, their respective word marks (e.g. GRIDCOOLER, DuraCooler, and Duraweld) on their respective one-piece keel cooler products.

6. Fernstrum will promptly withdraw its trademark application with prejudice.

7. Donovan Marine will dismiss with prejudice its breach of contract and false patent marking claims against Fernstrum (Civil Action No. 97-3974). Donovan Marine will also release any and all claims that it had, has, or may have against Fernstrum by reason of Fernstrum's termination of business relationships with Donovan Marine.

8. Fernstrum will dismiss with prejudice its Counterclaim, as amended and supplemented, against Donovan Marine in Civil Action No. 97-3974.

9. East Park will dismiss with prejudice its Declaratory Judgment Complaint against Fernstrum (Civil Action No. 97-3598).

10. Fernstrum will dismiss with prejudice its Complaint for Trademark Infringement, Trade Dress Infringement, Trade Dress Dilution, and Unfair Competition against East Park (Civil Action No. 97-3657).

11. Fernstrum and Duramax will release any and all claims that either party has or had against the other arising out of the sales and manufacture of a one-piece keel cooler.

12. All advertising placed 90 days hereafter by Duramax and East Park that depicts each one-piece keel cooler will clearly display the beveled end(s) of the header(s); Donovan Marine, Duramax and East Park may exhaust their respective advertising materials depicting their keel coolers as presently configured.

13. Donovan, et al agree not to use the word or term "Grid" in any advertisements or promotional materials relating to their respective one-piece keel cooler products.

14. All parties will bear their own costs and attorney fees in connection with the civil actions and trademark proceedings.

15. Within sixty days after the entry of the Stipulated Order of Dismissal in the litigation,

objects, and other materials produced or designated as Confidential Information and all reproductions thereof shall be returned to the producing party, except documents filed with the Court or presented to the Court as evidence in connection with these actions.

16. In the event Duramax files a trademark application(s) including the design of its beveled keel cooler, Fernstrum agrees not to oppose or otherwise contest said application or file a petition to cancel any registration issuing from said application.

17. The parties will request the Court to retain jurisdiction over the parties to enforce the terms of the Agreement.

IN WITNESS WHEREOF and with the intention of being legally bound, the parties and Duramax, Inc. have signed this Agreement on the date listed below.

R.W. FERNSTRUM & COMPANY

By: Paul W. Fernstrum
Paul W. Fernstrum, President

Date: MAY 5, 1999

DONOVAN MARINE, INC.

By: J. Benton Smallpage
J. Benton Smallpage, Jr., President

Date: 5/6/99

DURAMAX, INC.

By: S. C. McCall

Date: 10 MAY 1999

EAST PARK RADIATOR & BATTERY SHOP, INC.

By: Todd P. Boudreaux
Todd Boudreaux, President

Date: 5-6-99

UNITED STATES DISTRICT COURT

EASTERN DISTRICT OF LOUISIANA

EAST PARK RADIATOR	*	CIVIL ACTION
	*	NO. 97-3598 c/w 97-3974
VERSUS		
	*	SECTION "S"
R.W. FERNSTRUM & COMPANY	*	MAG. DIV. "1"

STIPULATED ORDER OF DISMISSAL

The Court having been advised that the parties have agreed to settle this action, it is hereby ORDERED, ADJUDGED AND DECREED that:

1. This Court has jurisdiction over the parties and the subject matter of this suit.

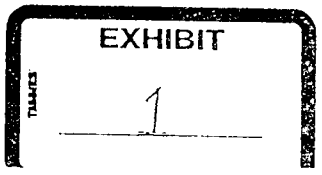
2. All claims and counterclaims in each of the cases consolidated hereunder are hereby dismissed with prejudice.

3. Each party shall bear its own costs and attorney fees.

4. This Court retains jurisdiction to enforce the Settlement Agreement.

Entered at New Orleans, Louisiana this _____ day of May, 1999.

MARY ANNE VIAL LEMMON
UNITED STATES DISTRICT JUDGE



APPROVED AND CONSENTED TO:

ATTORNEY FOR PLAINTIFF EAST PARK RADIATOR & BATTERY SHOP:

Garvey, Smith, Nehrbass & Doody, L.L.C.
3 Lakeway Center, Suite 3290
3838 N. Causeway Boulevard
Metairie, Louisiana 70002-1767

By:_____
Gregory C. Smith

ATTORNEY FOR PLAINTIFF DONOVAN MARINE, INC.:

Deutsch, Kerrigan & Stiles, L.L.C.
755 Magazine Street
New Orleans, Louisiana 70130

By:_____
David M. Culpepper

ATTORNEY FOR DEFENDANT:

Dickinson Wright PLLC
1901 L Street, N.W.
Washington, D.C. 20036-3506

By:_____
Samuel D. Littlepage

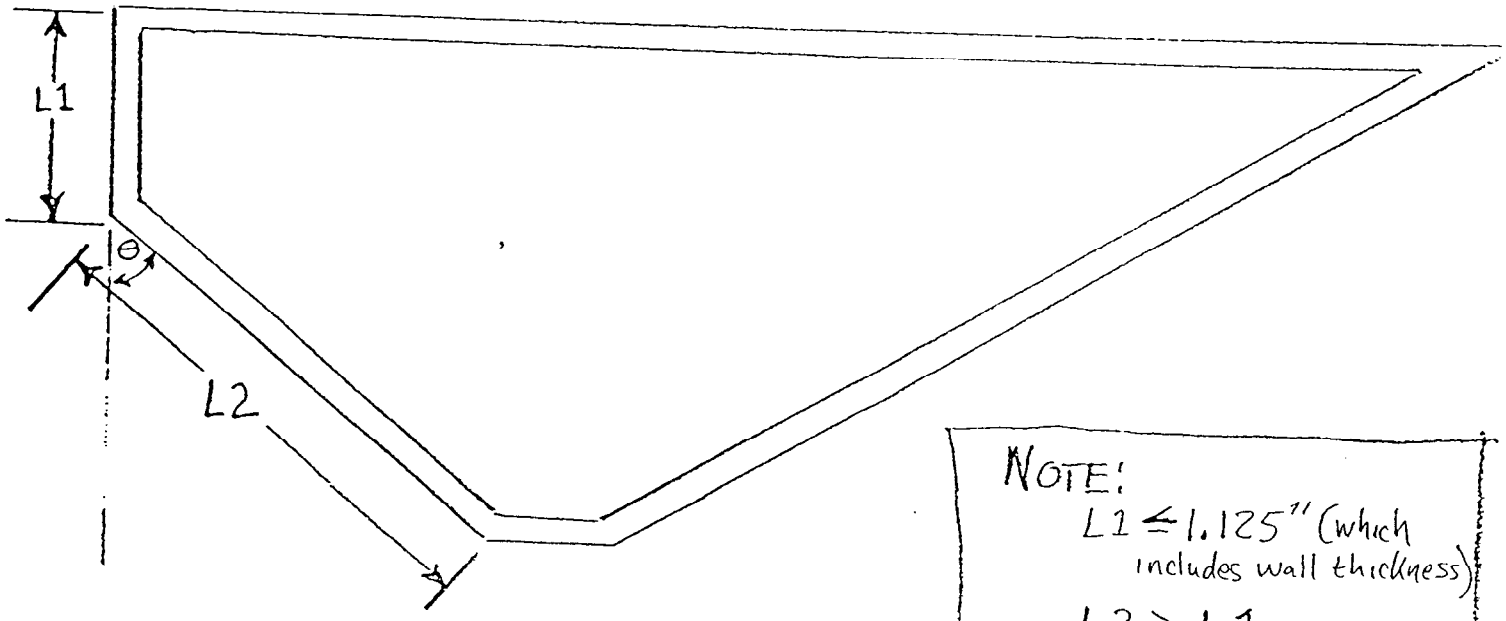
CONFIDENTIAL

MIKE BRAKEY

5/5/99

Illustration of proposed header chamfer configuration for 2.5" tall rectangular tube.

Michael M Brakey



NOTE:

$L1 \leq 1.125$" (which includes wall thickness)

$L2 > L1$

$\theta \geq 40°$

Applies to all B, C, D Models

EXHIBIT

2

SETTLEMENT AND MUTUAL RELEASE AGREEMENT

This Settlement and Mutual Release Agreement (the "Agreement") is made and entered into by, between and among:

(a) R.W. Fernstrum & Company ("Fernstrum"), a corporation organized and existing under the laws of the State of Michigan, represented herein by Paul W. Fernstrum, its duly authorized president;

(b) East Park Radiator & Battery Shop, Inc. ("East Park"), a corporation organized and existing under the laws of the State of Louisiana, represented herein by Todd Boudreaux, its duly authorized president;

(c) Donovan Marine, Inc. ("DMI"), a corporation organized and existing under the laws of the State of Louisiana, represented herein by James A. Dicks, its duly authorized executive vice-president; and

(d) Duramax, Inc. ("Duramax"), a corporation organized and existing under the laws of the State of Ohio, represented herein by P.C. Miller, Jr., its duly authorized president;

who recite that:

WHEREAS, East Park has filed that certain civil action entitled "East Park Radiator & Battery Shop, Inc. versus R.W. Fernstrum & Company," bearing number 97-3598 on the docket of Section "S" of the United States District Court for the Eastern District of Louisiana, wherein East Park seeks a declaratory judgment that: (1) the configuration of the one piece keel cooler product sold by Fernstrum under the GRIDCOOLER trademark is totally functional and not susceptible of trade dress protection; (2) the original East Park keel cooler product, sold under the DURAWELD trademark, does not infringe any trade dress accorded to the GRIDCOOLER product; (3) the redesigned keel cooler product of East Park does not infringe the trade dress asserted by Fernstrum; and (4) East Park is not engaging in unfair competition by employing and/or selling the original or redesigned DURAWELD keel cooler manufactured by East Park;

WHEREAS, Fernstrum has filed that certain civil action entitled "R.W. Fernstrum & Company versus East Park Radiator & Battery Shop, Inc.," bearing number 97-3657 on the docket of Section "S" of the United States District Court for the Eastern District of Louisiana, wherein Fernstrum alleges that: (1) East Park's use of "GRID COOLER" in connection with its business infringes the exclusive rights owned by Fernstrum in its federally-registered trademark (U.S. Reg. No. 941,382) in violation of 15 U.S.C. § 1114(1); (2) East Park's copying of the distinctive appearance of Fernstrum's GRIDCOOLER keel cooler has caused, and is likely to cause, confusion on the part of the relevant trade and purchasing public; (3) East Park's use of Fernstrum's model numbers in connection with its business operations is likely to cause confusion on the part of the relevant trade and purchasing public in violation of 15 U.S.C. §1125(a); (4) East Park's use of the GRIDCOOLER mark and the GRIDCOOLER trade dress is likely to dilute the distinctive qualities of the trademark and trade dress in violation of 15 U.S.C. § 1125(c); and (5) East Park's unlawful misappropriation of Fernstrum's trademark, trade dress, and methods of doing business are likely to cause confusion or mistake on the part of the relevant trade and consuming public constituting unfair competition;

WHEREAS, DMI has filed that certain civil action entitled "Donovan Marine, Inc. versus R.W. Fernstrum & Company," bearing number 97-3974 on the docket of Section "S" of the United States District Court for the Eastern District of Louisiana, wherein DMI seeks monetary damages against Fernstrum for breach of contract for the termination of DMI's distributorship relationship with Fernstrum and recovery of fines and penalties for violations by Fernstrum of 35 U.S.C. §292;

WHEREAS, in the above civil action number 97-3974, Fernstrum has counterclaimed against DMI alleging that: (1) Donovan Marine actively assisted a manufacturing competitor of Fernstrum

(later shown to be Duramax) to design, develop, test, and sell a keel cooler replicating the grid-like appearance of the Fernstrum product in violation of 15 U.S.C. § 1125(a); (2)The sale of the Duramax DuraCooler keel cooler by Donovan Marine has caused, and is likely to cause, confusion on the part of the relevant trade and purchasing public; (3) The sale of the Duramax DuraCooler keel cooler by Donovan Marine constitutes the unlawful misappropriation of Fernstrum's trade dress and is likely to cause confusion or mistake on the part of the relevant trade and consuming public constituting unfair competition; (4) Donovan Marine's use of "GRID COOLER" in connection with its business and the promotion of non-Fernstrum keel coolers infringes the exclusive rights owned by Fernstrum in its federally-registered GRIDCOOLER trademark (U.S. Reg. No. 941,382) in violation of 15 U.S.C. § 1114(1); (5) Donovan Marine's use of the GRID COOLER mark is likely to dilute the distinctive qualities of Fernstrum's GRIDCOOLER the trademark in violation of 15 U.S.C. § 1125(c); and (6) Donovan Marine's unlawful misappropriation of Fernstrum's trademark and trade dress have caused, and are likely to cause, confusion or mistake on the part of the relevant trade and consuming public constituting unfair competition in violation of 15 U.S.C. § 1125(a) and Louisiana common law and that state's Unfair Trade Practices and Consumer Protection Law;

WHEREAS, the above-described civil actions numbers 97-3598, 97-3657 and 97-3974 (hereinafter referred to collectively as the "Litigation") were consolidated for purposes of trial;

WHEREAS, trial in the above Litigation commenced on May 3, 1999 before United States District Judge Mary Ann Vial Lemmon (the "Court");

WHEREAS, Fernstrum, East Park and DMI agreed to settle the claims asserted in the above Litigation during a conference with the Court on May 5, 1999;

WHEREAS, in order to settle and adjust their differences, Fernstrum, East Park and DMI entered into that certain Term Sheet, effective as of May 5, 1999, which set forth in general the terms and provisions for the settlement and compromise of the Litigation, upon the terms and conditions set forth below, which each of the parties prefers to the hope of gaining balanced against the danger of losing;

WHEREAS, although not a party to the Litigation, Duramax appeared and intervened in the Term Sheet to the extent and for the purposes set forth therein and does now so appear and enter into this Agreement; and

WHEREAS, pursuant to the directive of the Court, the Term Sheet, as executed by Fernstrum, East Park, DMI and Duramax, was filed in the record of the Litigation on May 11, 1999;

NOW THEREFORE, in consideration of the premises and in order to implement the transactions contemplated by the Term Sheet and to settle and compromise the differences between Fernstrum, East Park, DMI and Duramax, it is agreed by and among the parties hereto that:

1. Fernstrum does hereby release, waive and forever discharge DMI, together with its successors, assigns, subsidiary and affiliated corporations, officers, directors, employees and agents, of and from any and all damages, attorneys' fees, punitive damages, injunctive and/or equitable relief, demands, liability and rights, claims or causes of action of whatsoever kind, whether presently asserted in the Litigation or which could have been asserted by Fernstrum in the Litigation.

2. DMI does hereby release, waive and forever discharge Fernstrum, together with its successors, assigns, subsidiary and affiliated corporations, officers, directors, employees and agents, of and from any and all damages, attorneys' fees, punitive damages, injunctive and/or equitable

relief, demands, liability and rights, claims of causes of action of whatsoever kind, whether presently asserted in the Litigation or which could have been asserted by DMI in the Litigation.

3. Fernstrum does hereby release, waive and forever discharge East Park, together with its successors, assigns, subsidiary and affiliated corporations, officers, directors, employees and agents, of and from any and all damages, attorneys' fees, punitive damages, injunctive and/or equitable relief, demands liability and rights, claims or causes of action of whatsoever kind, whether presently asserted in the Litigation or which could have been asserted by Fernstrum in the Litigation.

4. East Park does hereby release, waive and forever discharge Fernstrum, together with its successors, assigns, subsidiary and affiliated corporations, officers, directors, employees and agents, of and from any and all damages, attorneys' fees, punitive damages, injunctive and/or equitable relief, demands, liability and rights, claims of causes of action of whatsoever kind, whether presently asserted in the Litigation or which could have been asserted by East Park in the Litigation.

5. Fernstrum agrees to indemnify and hold harmless DMI and its successors, assigns, subsidiary and affiliated corporations, officers, directors, employees and agents, from and against any and all damages, attorneys' fees, punitive damages, injunctive and/or equitable relief, demands, liability and rights, claims or causes of action of whatsoever kind, whether presently asserted by Fernstrum against DMI in the Litigation of which could have been asserted by Fernstrum against DMI in the Litigation.

6. DMI hereby agrees to indemnify and hold harmless Fernstrum and its successors, assigns, subsidiary and affiliated corporations, officers, directors, employees and agents, from and against any and all damages, attorneys' fees, punitive damages, injunctive and/or equitable relief, demands, liability and rights, claims or causes of action of whatsoever kind, whether presently

asserted by DMI against Fernstrum in the Litigation of which could have been asserted by DMI against Fernstrum in the Litigation.

7. Fernstrum hereby agrees to indemnify and hold harmless East Park and its successors, assigns, subsidiary and affiliated corporations, officers, directors, employees and agents, from and against any and all damages, attorneys' fees, punitive damages, injunctive and/or equitable relief, demands, liability and rights, claims or causes of action of whatsoever kind, whether presently asserted by Fernstrum against East Park in the Litigation of which could have been asserted by Fernstrum against DMI in the Litigation.

8. East Park hereby agrees to indemnify and hold harmless Fernstrum and its successors, assigns, subsidiary and affiliated corporations, officers, directors, employees and agents, from and against any and all damages, attorneys' fees, punitive damages, injunctive and/or equitable relief, demands, liability and rights, claims or causes of action of whatsoever kind, whether presently asserted by East Park against Fernstrum in the Litigation of which could have been asserted by East Park against Fernstrum in the Litigation.

9. Fernstrum, East Park and DMI hereby agree that all claims and counterclaims asserted in the Litigation shall be dismissed with prejudice through the filing and entry in the Litigation of a Stipulated Order of Dismissal substantially in the form of Exhibit 1 attached to the said Term Sheet.

10. Fernstrum hereby stipulates and agrees that DMI, East Park and Duramax may, without restriction, sell their existing stock of one-piece keel coolers, and additionally, Fernstrum further agrees that DMI, East Park and Duramax shall have a period of ninety (90) days from and after May 5, 1999 within which to sell and/or manufacture additional keel coolers (over and above

their existing stock) to fill existing orders and new orders received during the said 90 day period. DMI and East Park hereby agree that the existing stock of one-piece keel coolers shall consist of those keel coolers whose respective serial numbers are set forth on written notice thereof provided by counsel for DMI and East Park to counsel for Fernstrum within ten (10) days of the date of entry of the above Stipulated Order of Dismissal.

11. As of the expiration of the ninety (90) day period set forth above, Duramax and East Park agree to modify the design and configuration of their respective one-piece keel coolers so as to incorporate beveled fore and aft header portions as generally set forth on Exhibit 1. The parties hereto acknowledge and agree that Exhibit 1 is a drawing which was negotiated and agreed upon during a recess from the trial in Civil Action Nos. 97-3974 and 97-3598 in the Eastern District of Louisiana (in New Orleans) on or about May 5, 1999, and is not made to scale. Exhibit 1 does show in general terms a side view of one end of a header for a beveled keel cooler having rectangular coolant flow tubes. Exhibit 1 does show that L1 shall be no greater than 1.125 inches, L2 shall be greater than L1 and that θ shall be greater than, or equal to,40°. It is also agreed that Exhibit 1 shows that any beveled keel cooler according to this Agreement does not have a rectangular configuration where L2 is perpendicular to L1 as in Fernstrum's GRIDCOOLER keel cooler. It is further stipulated by the parties that in the event that Fernstrum no longer uses a header configuration consisting of a vertical edge at the aft and fore of the headers on its GRIDCOOLER keel cooler, then at such time Duramax and East Park shall not be required to use the header design modification as illustrated on Exhibit 1 and shall at that time be free to adopt and use the vertical edge header configuration previously utilized on Fernstrum's GRIDCOOLER keel cooler.

12. Upon the expiration of the ninety (90) day period set forth above, all parties hereto agree to permanently mark, affix or imprint their respective word marks (*e.g.*, GRIDCOOLER, DuraCooler, and DURAWELD) on their respective one-piece keel cooler products.

13. Upon the expiration of the ninety (90) day period set forth above, all advertising thereafter placed by Duramax and East Park that depicts their respective one-piece keel coolers will clearly display the beveled end(s) of the header(s) configured in accordance with the provisions of paragraph 11 of this Agreement; provided, however, without limitation or restriction, DMI, Duramax and East Park may exhaust their respective existing advertising materials depicting their respective keel coolers as presently configured. Fernstrum further stipulates and agrees that upon the expiration of the ninety (90) day period set forth above, DMI, Duramax and East Park shall not be required to recall, destroy or issue any disclaimers in connection therewith, any catalogs, promotional materials or other advertising materials depicting their respective one-piece keel coolers as presently configured.

14. DMI, East Park and Duramax each agree that their respective advertisements and/or promotional materials relating or featuring their respective one-piece keel coolers will not hereafter use the word or term "Grid."

15. Within ten (10) days of the entry of the Stipulated Order of Dismissal in the Litigation, Fernstrum shall take such action as may be necessary to effect the withdrawal, with prejudice, of its application (application Serial No. 75/382,250) to federally register the configuration of its one-piece keel cooler product as a trademark now pending before the Trademark Trial and Appeal Board of the U.S. Patent and Trademark Office (the "trademark proceedings"). Nothing

herein shall preclude Fernstrum from seeking to register, in two dimensional design format, its trademark logo featuring its one-piece keel cooler as part of said design.

16. In consideration of the foregoing, Fernstrum expressly covenants not to sue and does hereby release, waive and forever discharge Duramax and East Park, together with their successors, assigns, subsidiary and affiliated corporations, officers, directors, employees and agents, of and from any and all damages, attorneys' fees, punitive damages, equitable and injunctive relief, costs, demands, liability, rights, claims or causes of action of whatsoever kind, whether now known or hereafter discovered, arising in any way out of the facts and/or claims asserted by Fernstrum in the Litigation or which could have been asserted by Fernstrum in the Litigation.

17. In consideration of the foregoing release by Fernstrum, Duramax and East Park expressly covenant not to sue and do hereby release, waive and forever discharge Fernstrum, together with its successors, assigns, subsidiary and affiliated corporations, officers, directors, employees and agents, of and from any and all damages, attorneys' fees, punitive damages, equitable and injunctive relief, costs, demands, liability, rights, claims or causes of action of whatsoever kind, whether now known or hereafter discovered, arising in any way out of the facts and/or claims asserted (or which could have been asserted) by DMI, Fernstrum and East Park in the Litigation or arising in any way from the facts asserted in said Litigation.

18. Fernstrum stipulates and agrees that in the event Duramax or East Park files a trademark application(s) with the U.S. Patent and Trademark Office, which includes the two-dimensional design of their beveled one-piece keel cooler, Fernstrum will not oppose or otherwise contest said application and Fernstrum will not file a petition or other proceeding to cancel any registration issuing from said trademark application.

19. All parties to this Agreement agree that a copy of this Agreement shall be filed in the record of the Litigation, and that the Court in the Litigation shall retain jurisdiction over the parties hereto in order to effectuate and enforce the terms and provisions of this Agreement.

20. Within sixty (60) days after entry of the Stipulated Order of Dismissal in the Litigation, those objects, documents and other materials produced or designated as Confidential Information, and all reproductions thereof, shall be returned to the producing party, less and except those documents filed with the Court or presented to the Court a evidence in connection with the Litigation.

21. This Agreement is entered into without any admission of liability on the part of any party hereto (which said liability is expressly denied), and is entered into by Fernstrum, DMI, East Park and Duramax solely and only for the purposes of effecting the releases and settlements set forth herein and carrying out the provisions of the Term Sheet without the necessity of further legal action.

22. Each of the parties hereto hereby represents that said party has entered into this Agreement of its own free will, after reading same and conferring with its respective counsel, and has not been induced to execute this Agreement as a result of any action, promise or representation other than those which are expressly set forth in this Agreement.

23. Each of the parties to this Agreement shall bear their own costs, expenses and attorneys' fees incurred in connection with the Litigation and the trademark proceedings.

24. The terms and provisions of this Agreement shall inure to the benefit of, and shall be binding upon, all subsidiaries, affiliates, successors, assigns and/or related companies or entities controlled by the parties hereto (including but not limited to Progressive Allied Industries, Inc.) and

shall serve to protect and be for the express benefit of all customers, agents and other persons acting for the benefit of the parties with respect to the transactions and occurrences dealt with herein.

THUS DONE AND EXECUTED, in multiple originals on the dates hereinafter set forth but all as of May 5, 1999, which is the effective date hereof.

WITNESSES:

_____

_____

_____

_____

_____

_____

_____

_____

R.W. Fernstrum & Company

By: Paul W. Fernstrum

Paul W. Fernstrum, President

Date: 7/21/99

Donovan Marine, Inc.

By: James A. Dicks

James A. Dicks, Executive Vice-President

Date: 7-16-99

East Park Radiator & Battery Shop, Inc.

By: _____

Todd Boudreaux, President

Date: _____

Duramax, Inc.

By: P.C. Miller

P.C. Miller, Jr., President

Date: 29 July 1999

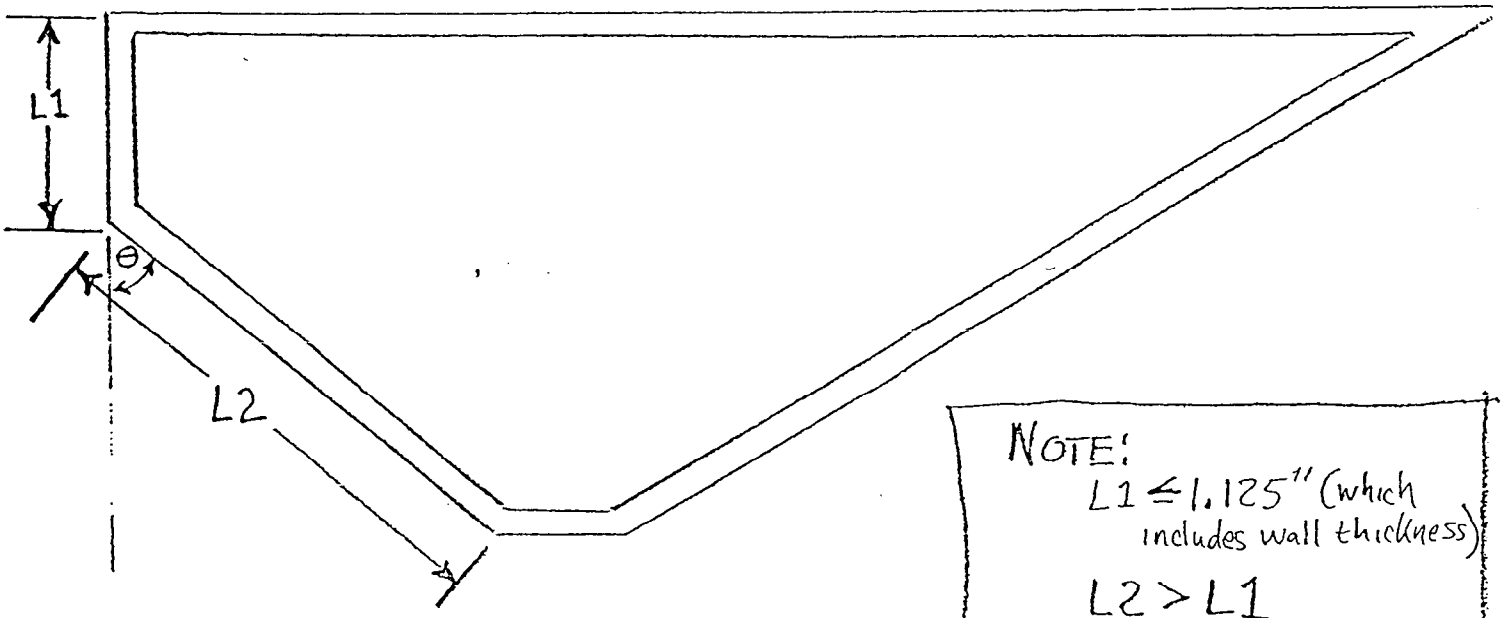
CONFIDENTIAL

MIKE BRAKEY

5/5/99

Illustration of proposed header chamfer configuration for 2.5" tall rectangular tube.

Michael W Brakey



NOTE:

$L1 \leq 1.125$" (which includes wall thickness)

$L2 > L1$

$\theta \geq 40°$

Applies to all B, C, D Models

EXHIBIT

"1"

IN THE UNITED STATES DISTRICT COURT

FOR THE WESTERN DISTRICT OF MICHIGAN

SOUTHERN DIVISION

R. W. FERNSTRUM & COMPANY,

Plaintiff,

v. CASE NO: 2:00-CV-194

DURAMAX MARINE, L.L.C,

Defendant.

_____/

* * * *

COURT'S RULING REGARDING

MOTION FOR PRELIMINARY INJUNCTION

* * * *

BEFORE: THE HONORABLE RICHARD ALAN ENSLEN
United States District Judge
Kalamazoo, Michigan
December 5, 2000

APPEARANCES:

APPEARING ON BEHALF OF THE PLAINTIFF:

SAMUEL D. LITTLEPAGE
Dickinson, Wright, Moon, VanDusen, et al
1901 L Street, N.W., Suite 800
Washington, D.C. 20036

KEVIN J. O'DOWD
Dickinson Wright, PLLC
200 Ottawa Avenue, N.W., Suite 900
Grand Rapids, Michigan 49503

APPEARING ON BEHALF OF THE DEFENDANT:

STEPHEN P. AFENDOULIS
Varnum, Riddering, Schmidt & Howlett, LLP
330 Bridge Street, N.W.
P.O. Box 352
Grand Rapids, Michigan 49501-352

Kalamazoo, Michigan

December 5, 2000

at approximately 10:53 a.m.

* * * *

EXCERPT OF PROCEEDINGS

* * * *

THE COURT: The Plaintiff Fernstrum moved on November 28th for a temporary restraining order and preliminary injunction. By my Order of November 29th, I denied the request for the temporary restraining order and set a preliminary injunction hearing for today. I set time limits for the presentations, 50 minutes each, defendant used about all of its time, the plaintiff did not use all of its time.

I have read all the materials that were brought here quickly, and I have now heard the arguments. Upon review of the evidence submitted by the parties, both by affidavit and by testimony of one witness today, I now make findings of fact and law pertinent to the preliminary injunction motion.

Plaintiff R.W. Fernstrum and Company is a manufacturer of keel coolers, which are essentially cooling devices for ship and large boat engines, and its named brand product is the Fernstrum Enhanced Gridcooler. Defendant Duramax Marine is also a manufacturer of keel

coolers and the brand name of its product is DuraCooler. Both parties compete in the same market. They market to their customers in trade publications such as The Maritime Reporter and Engineering News, Work Boat and National Fisherman. In the latter part of September this year, plaintiff learned that defendant had engaged in an advertising campaign which advertised that its product was "the best by test." Those ads with that language appeared in the October editions of The Maritime Reporter and Engineering News and Work Boat, and the November issue of National Fisherman. Each of these magazines contained the defendant's advertisements as well as plaintiff's own advertisement for its Enhanced Gridcooler. Each of the defendant's advertisements stated as follows, according to Plaintiff's Exhibit 1-E and 2:

"The Best by Test--"

This is all a quote.

"The Best by Test.

Go to www.duracooler.com and see why DuraCooler is the best by test. DuraCooler - the greatest innovation in keel cooler technology in over 40 years - is the most efficient keel cooler of the industry. Its unique streamlined header enhances internal coolant and external seawater flow, while reducing system pressure drop and increasing cooling efficiency. This means optimum heat

transfer efficiency, small keel cooler requirements and a reduction in the cooling system costs.

"DuraMarine is constantly looking for ways to improve the DuraCooler design. Our extensive, full-scale, in-house testing program helps identify ways to improve our keel coolers, making them smaller and more affordable.

"DuraCooler is quickly becoming the keel cooler of choice by owners, architects and shipyards around the world. So forget the rest and choose the best by test, the DuraCooler from Duramax Marine. Visit www.duracooler.com for your free sizing today."

That is a literal quote from Plaintiff's Exhibit 1-E and 2.

Defendant's website, at least as it appeared on November 16th of this year, further explained this advertising and made testing claims. The website provided graphs comparing computer models of the "traditional keel cooler" to the DuraCooler. It then made the claim that it had conducted a test on the DuraCooler (model SC-48-96) versus "an equivalent size square-head unit" and that the test showed that the DuraCooler increased heat transfer by 17 percent. It also made the claim that the initial tests validated the computer testing. That appeared to the Court in Plaintiff's Exhibit 3.

Plaintiff's current president, Paul Fernstrum, by his affidavit in support of the motion for preliminary injunction, seeks to distinguish his product, the Enhanced Gridcooler, from traditional keel coolers. According to Fernstrum, his company discovered in 1995 that enhanced tubing, that is to say, tubing which possesses conical protrusions, could result in significantly better heat transfer, meaning an improvement of up to 30 to 35 percent compared to the traditional smooth-walled keel coolers. Naturally in this day and age, that had to be called a dimple. This discovery led to the development of its Enhanced Gridcooler product, which debuted in 1998 and 1999 World Boat trade show. Fernstrum also claims that this enhancement made the Enhanced Gridcooler much more efficient than traditional keel coolers.

Plaintiff's argument for injunctive relief is that defendant's advertising claims to the effect that the DuraCooler has been tested to be the most efficient cooler in the industry is literally false in that defendant has not tested its DuraCooler against the Enhanced Gridcooler as well as many other models in the industry. Plaintiff desires that this injunctive relief be entered prior to December 6th, tomorrow, which is the opening day for a marine industry trade show in which both the defendant and the plaintiff plan to participate, and in which defendant

plans to use the advertising claims that I have just outlined.

Defendant's response to the plaintiff's motion gives a great number of reasons for denying the requested relief. Not the least of which is an affidavit by Michael Brakey, the consultant hired by defendant to test its DuraCooler products. According to Brakey, he did in fact perform comparative tests of the DuraCooler against the Enhanced Gridcooler between May and October of 2000 and determined that the DuraCooler outperformed the Enhanced Gridcooler. That is in the Brakey affidavit, Paragraphs 8 to 12. Brakey also gave his opinion in that affidavit that consumers in DuraCooler's market, "rigid keel coolers," which refer to rigid, one-piece coolers, are not interested in other products like the Johnson and Walter machine "demountable keel coolers" because they are much larger than the "rigid keel coolers" and, consistent with its advertising, much less efficient. That's my reading of Paragraphs 13 to 15 in Brakey's affidavit.

Brakey's affidavit otherwise explains the scientific basis for his testing conclusions, down to the formula for heat transfer coefficient calculations. John Krawczyk, the president and CEO of Flow Simulation, Inc., has also filed his affidavit, which states that the computation flow dynamics computer programs used in the

testing are reasonably reliable at lower flow rates in reaching scientific conclusions regarding keel coolers. Those are Paragraphs 9 and 10 of the Krawczyk affidavit.

Plaintiff's response or reply to the response was filed yesterday at 3:54 p.m., something I noted earlier today. It makes several arguments, some accusations as to defendant's response.

First, it argues that there is undisputed testimony that defendant did not test all models of keel coolers in the industry. For this proposition, plaintiff cites the testimony of Ben Kingery, the advertising manager of defendant, that various models of keel coolers, the East Park Radiator Company cooler, the Walter Machine Company cooler, and the Johnson Company cooler, Johnson without a T, were not compared to the DuraCooler by direct comparison test.

Second, plaintiff argues that defendant could not have completed its testing of the Enhanced Gridcooler by the time that the advertisements were placed. Plaintiff makes this inference by noting that the first Enhanced Gridcoolers, which were sold to Kody Marine, K - Kody Marine, the place that defendant purchased the Enhanced Gridcooler, according to Mr. Kingery were delivered August 7th, 2000. Since they were tested in Ohio according to Mr. Kingery, which would have involved

some four days truck travel, the testing could not have been completed by August 11th, 2000, the date which Work Boat magazine closed its advertising for its October 2000 issue.

Third, plaintiff makes the point that the internet site that defendant has designed was designed in 1997 and 1998 based on computer testing and earlier testing which had nothing to do with Enhanced -- with the Enhanced Gridcooler.

Fourth, plaintiff, in the affidavit of Todd S. Fernstrum, the vice president of marketing for plaintiff, gives the opinion that defendant's testing is inadequate to provide conclusions as to all models of Enhanced Gridcoolers because other models of Enhanced Gridcoolers utilized more tubes and utilize a newly designed electrode bosses, which change the heat efficiencies of the products.

This morning I heard no testimony from the plaintiff and heard one witness called by the defendant, Michael Brakey, who also had an affidavit, as I indicated. Brakey clarified the nature of his testing and testing procedures and was of the opinion that the conclusions in the advertising were accurate notwithstanding recent changes to the Fernstrum products and notwithstanding that the test of the Fernstrum product

utilized an 8-tube unit. He also clarified Mr. Kingery was mistaken and indicating that defendant had purchased its test unit from Kody Marine since the unit had not been purchased there, but rather from Donovan Marine in May and tested thereafter.

In reviewing a preliminary injunction motion under Rule 65, this Court is required, of course, to consider four factors: First, plaintiff's likelihood of success on the merits; secondly, the irreparable harm that could result to the plaintiff if the injunction is not issued; third, the impact on the public interest; and fourth, the possibility of substantial harm to others caused by the requested injunction. That is the essentially the test in every circuit, and has been in this circuit every time since I've been on the bench, but the most recent that I know of is in a Sixth Circuit case called Basicomputer Corp. v. Scott, a 1992 Sixth Circuit decision. This evaluation focuses on all four factors, rather than any particular factor, which was the warning of the circuit in In re DeLorean Motor Company, in 1985.

Taking them seriatim, likelihood of success coming first, I say the following: This suit is brought pursuant to Section 43(a)(1)(B) of the Lanham Act, which is codified at 15 U.S.C. Section 1125(a)(1)(B), as well as state law claims which more or less simply repeat the

state law form the strictures of the Lanham Act. This section provides that:

"1125. False designations of origin, false descriptions and dilution forbidden.

(a) Civil action. (1) Any person who, on or in connection with any goods or services, or any container for goods, uses in commerce any word, term, name, symbol, or device, or any combination thereof, or any false designation of origin, false or misleading description of fact, or false or misleading representation of fact, which... skipping to (B) in commercial advertising or promotion, misrepresents the nature, characteristics, qualities or geographic origin of his or her or another person's goods, services or commercial activities, shall be liable in a civil action by any person who believes that he or she is likely to be damaged by such act.

This statute has been interpreted by the Sixth Circuit as creating a cause of action requiring the plaintiffs to prove five elements: To state a cause of action for misleading advertisement under Lanham, a plaintiff must establish the following:

First, that the defendant has made false or misleading statements of fact concerning his own product or another's; two, the statement actually or tends to deceive a substantial portion of the intended audience;

third, the statement is material in that it will likely influence the deceived consumer's purchasing decisions; four, the advertisements were introduced into interstate commerce; and five, there is some causal link between the challenged statements and harm to the plaintiff.

That comes from American Council of Certified Podiatric Physicians and Surgeons v. American Board of Podiatric Surgery, Inc., 185 F.3d 606, the quote from 613, a 1999 Sixth Circuit published opinion.

Notwithstanding the above definition of the cause of action, not all of these elements are pertinent to a request for injunctive relief. As the Sixth Circuit Court of Appeals stated in the American Council decision, the evidence of causation a plaintiff must introduce to establish a Lanham Act claim varies depending upon the relief sought. Regarding deception, "injunctive relief may be obtained by showing only that the defendant's representations about its product have a tendency to deceive consumers while recovery of damages requires proof of actual consumer deception." Citing an Eastern District of Pennsylvania case in 1985 and an Eighth Circuit case in 1980. "This lower standard--" continuing the quote, "has arisen because when an injunction is sought, courts may protect the consumer without fear of bestowing an undeserved windfall on the plaintiff." Then citing to

Black Hills Jewelry and J. Thomas McCarthy, in a book called McCarthy on Trademarks and Unfair Competition, at Section 27:31 in 1998.

Continuing the quote, "Although plaintiff need not present consumer surveys or testimony demonstrating an actual deception, it must present evidence of some sort demonstrating that consumers were misled." End of the Sixth Circuit quote in American Council. It comes from Page 618, Volume 185 of F.3d.

Furthermore, there is a legal presumption in Lanham Act cases that if advertising is literally false it will cause deception of consumers and likely influence purchasing decisions. See Porous Media Corp. v. Pall Corp., 110 F.3d 1329 and 1333 an Eighth Circuit case in 1997; Castrol v. Pennzoil, 987 F.2d 939 at 943, Third Circuit case in 1993; U-Haul International, Inc. v. Jartran, Inc., 793 F.2d 1034 at 1041, Ninth Circuit decision in 1996; Harper House, Inc. v. Thomas Nelson, Inc., 889 F.2d 197 at 209 from the Ninth Circuit in 1989; and finally, Resource Developers, Inc. v. Statue of Liberty-Ellis Island, 926 F.2d 134 at 140, of course from the Second Circuit, and in 1991. There is a hyphen between Liberty and Ellis.

In this case, plaintiff's theory of liability is that the advertising was literally false and that its

falsehood related to claims about its product testing. This is significant since the federal courts have announced special rules governing product testing claims. These rules were announced by the Second Circuit in Castrol v. Quaker State, that's 977 F.2d 57 at 62 in 1992, as follows:

"To succeed under 43(a), a plaintiff must demonstrate that 'an advertisement is either literally false or that the advertisement, though literally true, is likely to mislead and confuse consumers. Where the advertising claim is shown to be literally false, the court may enjoin the claim "without reference to the advertisement's impact on the buying public." I'm reading from McNeil- P.C.C., Inc. v. Bristol-Myers Squibb Co., 938 F.2d 1544 and 1549, a Second Circuit case in 1991 (quoting Coca-Cola at 690 F.2d 317) (citations omitted). Here, Castrol contends that the challenged advertisement is literally false. It bears the burden of proving this to a "likelihood of success" standard.

"As we have on two occasions explained, plaintiff bears a different burden in proving literally false the advertised claim that tests proved defendant's product superior, than it does in proving the falsity of a superiority claim which makes no mention of the tests...

A plaintiff's burden in proving literal falsity

thus varies depending on the nature of the challenged advertisement. Where the defendant's advertisement claims that its product is superior, plaintiff must affirmatively prove defendant's product equal or inferior. Where, as in the current case, defendant's ad explicitly or implicitly represents that tests or studies prove its product superior, plaintiff satisfies its burden by showing that the tests did not establish the proposition for which they were cited. McNeil, 938 F.2d at 1549. We have held that a plaintiff can meet this burden by demonstrating that the tests were not sufficiently reliable to permit a conclusion that the product is superior. Procter, 747 F.2d at 119; see also Alpo Pet Foods Inc. v. Ralston Purina Co., 720 F.Supp. 194 at 213, from the District of Columbia, in 1989, affirmed in part and reversed on other grounds, 913 F.2d 958 from the D.C. Circuit in 1990. American Home Products Corp. v. Johnson & Johnson, 654 F.Supp. 568 and 590, from the Southern District of New York in 1987; Thompson Medical Co. v. Ciba-Geigy Corp., 643 F.Supp. 1109 at 1196 to 99, another Southern District case in 1986. The Procter 'sufficiently reliable' standard of course assumes that the tests in question, if reliable, would prove the proposition to which they are cited. If plaintiff can show that the tests, even if reliable, do not establish the proposition asserted by the

defendant, the plaintiff has obviously met its burden. In such a case, tests which may or may not be 'sufficiently reliable' are simply irrelevant.

That is, the major quote comes from Castrol v. Quaker State, at 977 F.2d, the quotes are from Pages 62 and 63. These same legal principles relating to falsehood of product testing claims have been recognized by several other federal circuit courts of appeals. See C.B. Fleet Co., Inc., v.SmithKline Beecham Consumer Healthcare, 131 F.3d 430 at 435, a Fourth Circuit case in 1997. BASF Corp. v. Old World Trading Co., 41 F.3d 1081 at 1088-1091 a Seventh Circuit decision in 1994; Rhone-Poulenc Rorer Pharmaceuticals, Inc. v. Marion Merrell Dow, Inc., 93 F.3d 511 at 514 an Eighth Circuit case in 1996; and Southland Sod Farms v. Stover Seed Co., 108 F.3d 1134 at 1139 a Ninth Circuit case in 1997.

Furthermore, the fact the advertising in question did not make a direct comparison between the plaintiff and the defendant's products is not dispositive. That's Castrol at Page 946, different Castrol perhaps-- Castrol v. Pennzoil, 987 F.2d 939 at 946, Third Circuit 1993, a case in which Pennzoil claimed to have outperformed all leading motor oils in viscosity breakdown, the Third Circuit explained this rule as follows:

Moreover, there need not be a comparison to a competitor for a statement to be actionable under the Lanham Act. See American Home Products Corp. v. Johnson & Johnson, 654 F.Supp. 568, Southern District of New York in 1987, holding that the claim that Tylenol gives unsurpassed relief is not puffery despite the lack of direct comparison. Gillette, Number 89, a slip opinion at Page 42 for slip op. No. 3686. The claims "smoothest, most comfortable shave" is not puffery. Under Pennzoil's logic as Castrol points out, the Ford Motor Company could claim that its Pinto model offers the best rear end protection as long as no competitor is specifically named. Such a result is impractical and illogical."

The quote is from Castrol v. Pennzoil Co., Page 946; see also Gillette v. Norelco, 946 F. Supp. 115, 119, Footnote 2 from the District of Massachusetts in 1996.

In this case, the advertising claim was made as to all keel coolers in the industry and the claim appeared in magazines in which plaintiff regularly advertised its products. Thus, its logical to assume that the claim applied specifically to plaintiff's products.

One problem in assessing product testing claims is how to regard an advertisement which contain both general product claims couched in specific testing data which is more limited. One example of this scenario was

the advertising at issue in the Seventh Circuit case in Southland Sod Farms v. Stover Seed, that's-- I cited that before, I'll recite it, 108 F.3d 1134 at 1139, 1997 case. In that case, the Seventh Circuit Court of Appeals held there was a genuine issue of fact as to whether an advertisement claiming that Bonzai grass outperformed a competing turfgrass was literally false. The advertisement there at issue claimed that in comparison to tests Bonzai grass outperformed the competing grass, but the advertisement contained a disclaimer that this result was based on a four-month growth study. The plaintiff in Southland regarded the advertisement as literally false because its grass outperformed Bonzai in long-term growth and the test did not provide a basis for a conclusion as to long-term growth. In reaching its conclusion that there was a genuine issue of fact as to literal falsity, the Seventh Circuit relied upon the following rules in assessing advertisements:

"When evaluating whether an advertising claim is literally false, the claim must always be analyzed in its full context... 'In determining facial falsity the Court must view the face of the statement in its entirety, rather than examine the eyes, nose and mouth separately and in isolation from each other."

That's page 1139, citation is omitted.

In this case, the context for regarding these advertising claims is not the large consuming public, but rather a small group of very technically informed naval architects, marine engineers, shipwrights and large boat owners. This is important because, as one court has said, "Context can often be important in discerning the message conveyed and this is particularly important considering the target is not the consuming public, but really a more well informed and sophisticated audience of merchants." The quote comes from Plough v. Johnson & Johnson Baby Products, 532 F.Supp 714 to 718 from the District in Delaware in 1982. In the context of naval architects, marine engineers, shipwrights, and large boat owners, such buyers are unlikely to find the defendant's testing claims were literally false or that the testing either was unreliable or otherwise insufficient to prove the propositions asserted.

First, the Court believes that the buying audience would view the claims about the DuraCooler as claims about rigid, one-piece keel coolers and not as to claims about demountable keel coolers, which obviously serve a different market niche completely.

Second, the Court believes that this kind of sophisticated buying audience would understand that, in view of the fact that advertisements explicitly rely upon

both computer analysis and limited sample testing, that direct test comparisons were not performed on every model of keel cooler available in the market, particularly where new products are being introduced into the market on a constant basis.

Third, this kind of sophisticated buying audience would have appreciation of the computation flow dynamics utilized by Krawczyk and Brakey and would tend to regard this kind of analysis when coupled with sample testing as a generally reliable basis for the defendant's advertising claims.

Fourth, this kind of sophisticated audience is likely to understand defendant's advertising claims as a controversial scientific opinion for the purpose of product promotion and is likely to be wary of such advertising claims.

Fifth and finally, although the fact that some of the advertising claims made by DuraCooler predated their testing of the Enhanced Gridcooler may provide a basis for liability as to some past ads, it does not provide a basis to issue a prior restraint as a current advertising which later testing now supports as generally reliable. The First Amendment protects the right to free commercial speech which is true today even if it were false yesterday. Accordingly, the Court determines that

the plaintiff is not likely to prevail on the merits in that it cannot establish the literal falsity of defendant's advertising claims.

While it's not necessary to talk about the rest of the tests, I'm going to briefly talk about irreparable harm to the plaintiff.

While the victim of literally a false -- while the victim of literally false advertising does suffer irreparable harm within the meaning of Rule 65, the Court has found that it is unlikely that the plaintiff's arguments and false advertising will prevail. As such, the Court cannot find the irreparable harm to the plaintiff.

Irreparable harm to others. While no person has a constitutional right to promulgate falsehood, the defendant does have a constitutional First Amendment right to engage in truthful commercial advertisement. See U-Haul International v. Jartran, a Ninth Circuit case, 793 F.2d 1034 especially at 1042 and 1043. Since the Court has found that the defendant's advertisement is most likely truthful, the granting of an injunction would be an unlawful prior restraint on free speech and would irreparably harm the plaintiff. Therefore, this factor also favors the defendant.

Finally, the public interest. Plaintiff has

urged that it is in the public interest to prevent this advertisement because of the effect upon consumers. Because the Court determines that it is most likely that it would have a positive, non-deceptive effect upon the marketplace, the Court also determines that the public interest favors the denial of the injunction.

Therefore, the Court denies the plaintiff's motion for preliminary injunction and will enter a written order denying the injunction consistent with this opinion soon, perhaps today.

That concludes the business before the Court and the Court, therefore, adjourns.

MR. GURBST: Your Honor--

Never mind. Thank you.

COURT CLERK: All rise.

Court is adjourned.

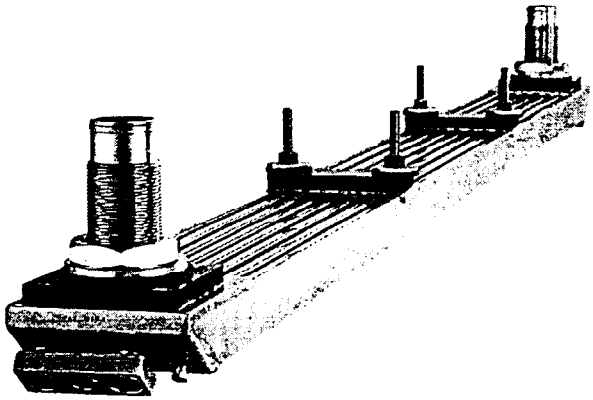
(At 11:25 a.m., proceedings were concluded.)

REPORTER'S CERTIFICATE

I, Kathleen S. Thomas, Official Court Reporter for the United States District Court for the Western District of Michigan, appointed pursuant to the provisions of Title 28, united States Code, Section 753, do hereby certify that the foregoing is a true and correct transcript of proceedings had in the within-entitled and numbered cause on the date hereinbefore set forth; and I do further certify that the foregoing transcript has been prepared by me or under my direction.

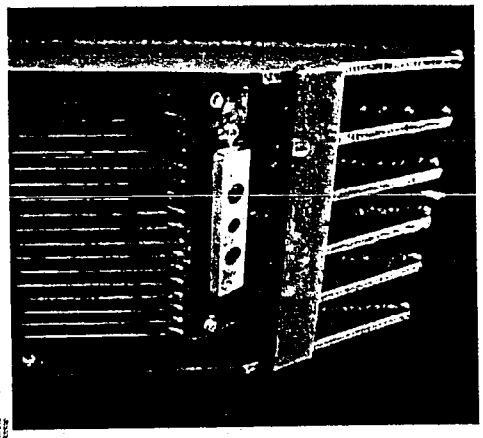
Kathleen S. Thomas

Kathleen S. Thomas, CSR-1300, RPR
U.S. District Court Reporter
410 West Michigan Avenue
Kalamazoo, Michigan 49007

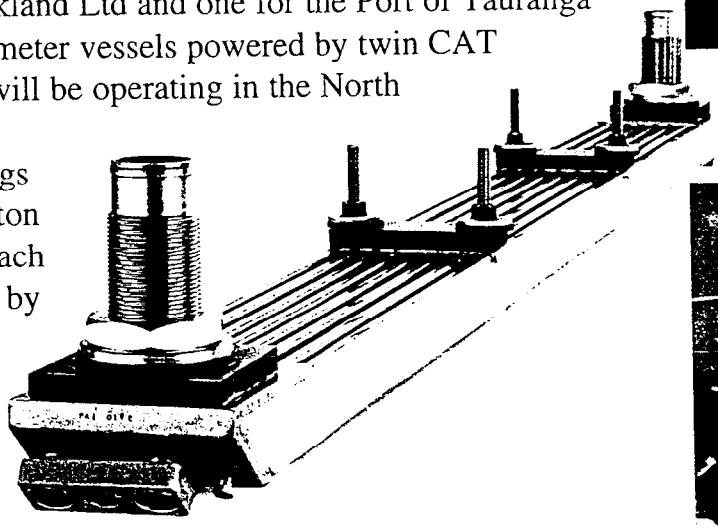


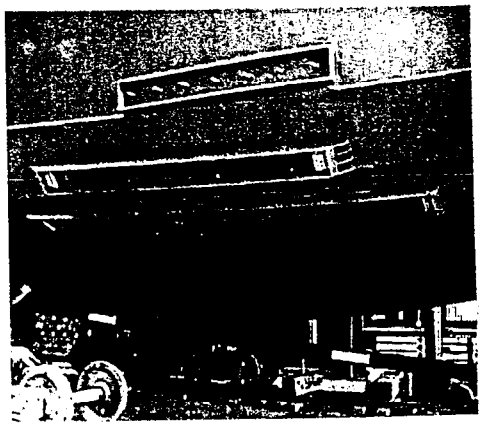
DuraCooler™

Northport Engineering LIMITED

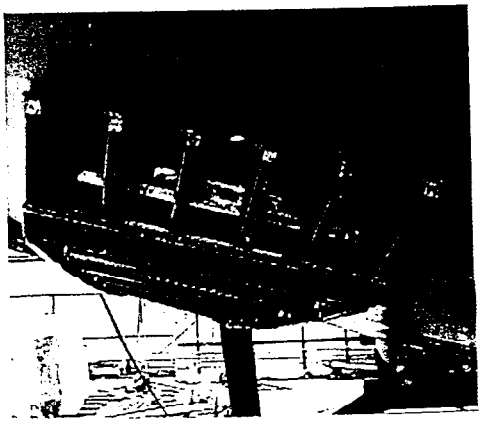


DuraCoolers™ are quickly becoming the keel cooler of choice around the world! Take, for example, Tug Waipapa, one of four harbour tugs being built at Northport Engineering Ltd in Whangarei, New Zealand. Three of these tugs are being built for Ports of Auckland Ltd and one for the Port of Tauranga Ltd. All are 22 meter vessels powered by twin CAT 3516 EIUs and will be operating in the North Island of New Zealand. The tugs will be push button controlled and each will be operated by a crew of two. The main engines are cooled by SC-418-168 units and the Ulstein propeller units, steering and winch hydraulics are cooled by SC-212-120 DuraCoolers by Duramax® Marine LLC and distributed by Morse Controls (NZ) Ltd.





DuraCoolers are the first innovation in keel cooling technology in over half a century. Its streamlined header reduces pressure drops in the system and more efficiently uses the coolers' capacity to bring the customer a more efficient, durable keel cooler. And Duramax Marine LLC has taken the guess work out of keel cooler sizing with its years of research and development and in-house, computerized sizing system. Whether it is for retrofit or new construction, there is a size that meets your requirements.



Photos Courtesy of Ford Off Shore Services Ltd New Zealand

Sales & Services

801 Odette Street
Houma, Louisiana 70363
Telephone: 504-876-3120
504-876-6944
Fax: 504-876-0305

EAST PARK RADIATOR & BATTERY SHOP, INC.

Mission Statement

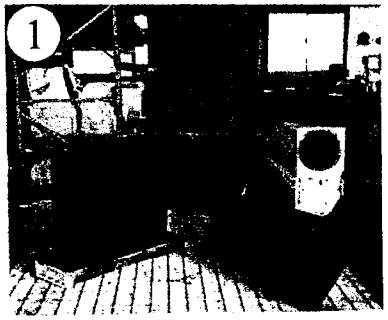
East Park Radiator is committed to providing impeccable quality and service to its customers through continued research, design and testing of its own products and the other products it services for the marine and oilfield industry.

History

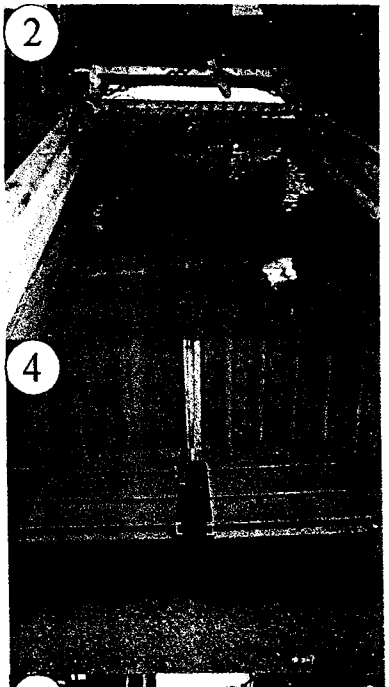
East Park Radiator was started in 1962 as a radiator repair and battery facility. Since its inception, East Park Radiator has evolved into a major repair facility servicing radiators, tube and shell heat exchangers, aftercoolers, inner coolers, air exchanger and keel coolers for the marine and oilfield industry. After years of extensive repair to marine and oilfield heat transfer equipment, East Park Radiator & Battery Shop, Inc. applied its knowledge and experience to the development and manufacturing of its' own keel cooler and replacement tube and shell heat exchangers. East Park Radiator & Battery Shop, Inc. gained insight into the concerns of its customers based on prior equipment failures and used this insight to develop our improved products.

HEAT EXCHANGERS & OIL COOLERS

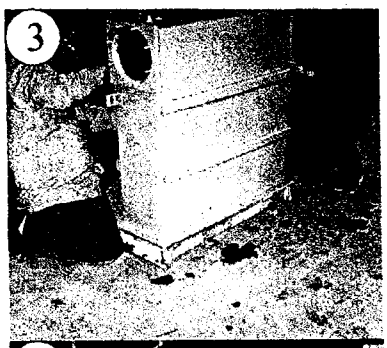
Service & Repair



1. EMD accessory rack oil cooler during disassembly.

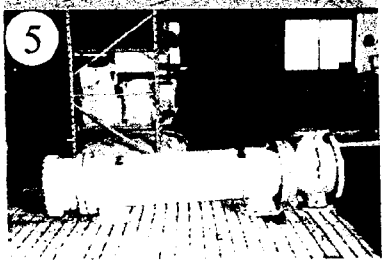


2. EMD accessory rack oil cooler being pressure tested before reassembly.



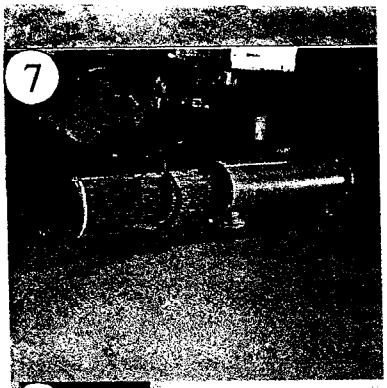
3. EMD accessory rack oil cooler being reassembled.

4. EMD accessory rack oil cooler ready for delivery.

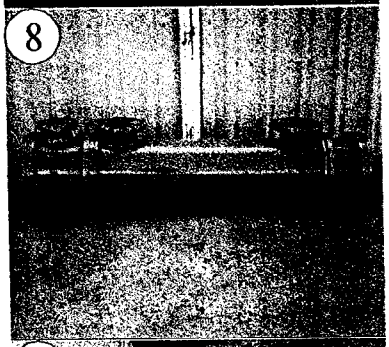


5. EMD 20645E7B jacket water heat exchanger before disassembly.

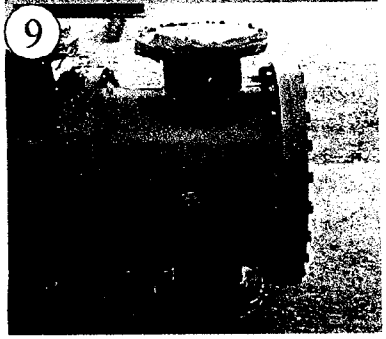
6. EMD jacket water heat exchanger disassembled.



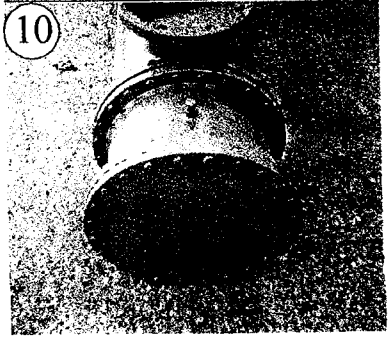
7. EMD jacket water heat exchanger tube bundle being installed into the housing.



8. EMD jacket water heat exchanger ready for delivery, after being pressure tested and painted.



9. Stainless steel inserted inlet/outlet bonnet fabricated to replace original. The original cast iron bonnet was not repairable.

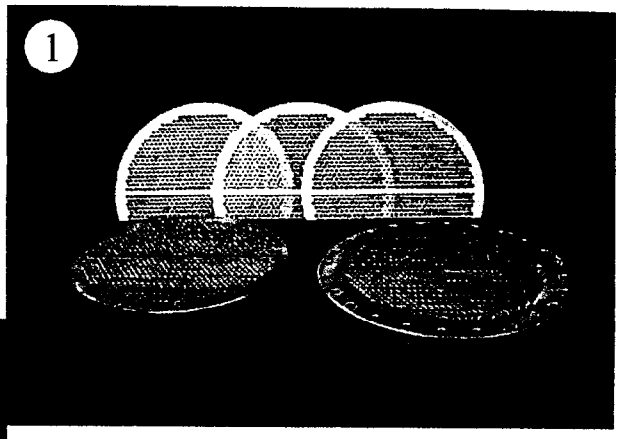


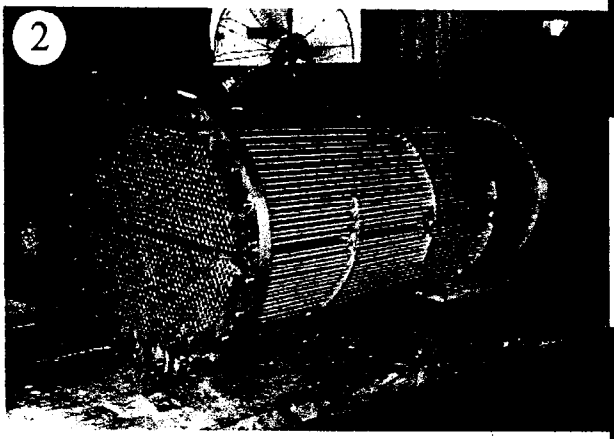
10. Stainless steel inserted return bonnet fabricated to replace the original.

HEAT EXCHANGERS & OIL COOLERS

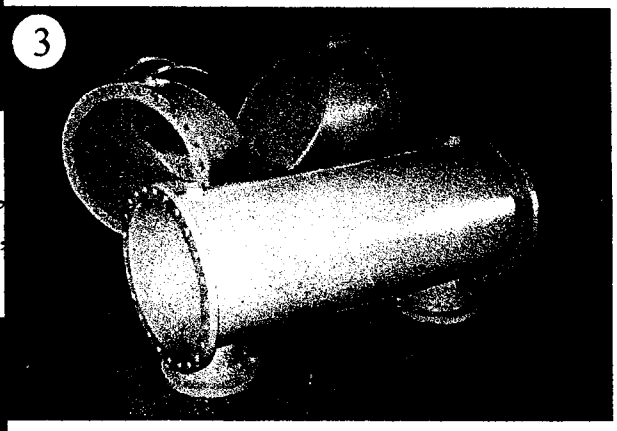
16645E7B EMD Oil Cooler
(Replaces Young OEM Models)

1. Machined naval brass tubesheets and baffles, ready for tube installation.

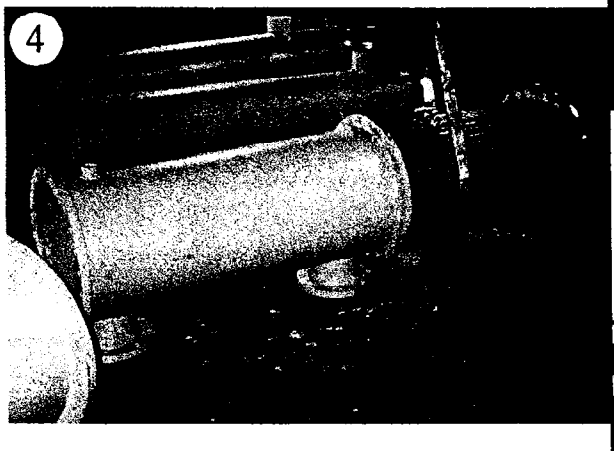




2. Completed tube bundle ready to be installed into housing.



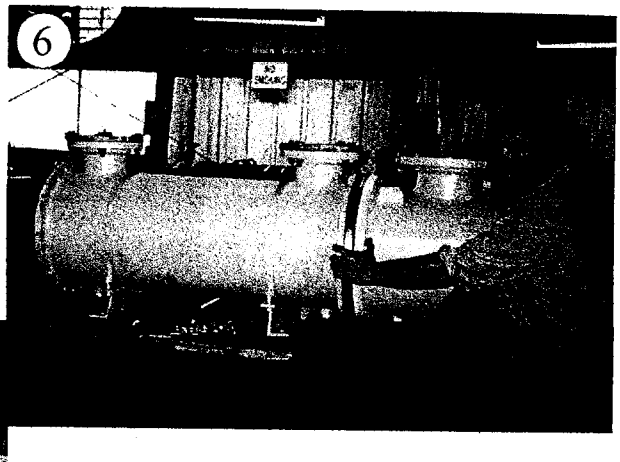
3. Carbon steel housing and end bonnets, that have been sandblasted and coated, waiting for assembly.



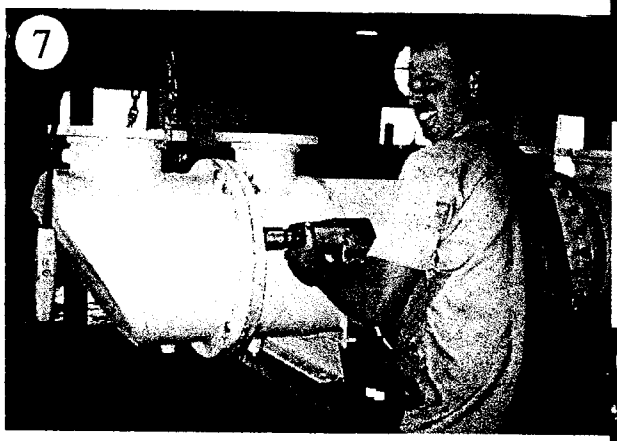
4. Tube bundle being installed into housing.

5. Tube bundle is being pressure tested to verify tubesheet to tube bond integrity.

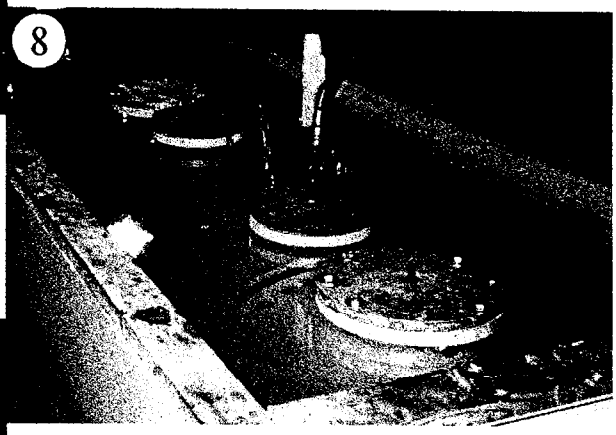
HEAT EXCHANGERS & OIL COOLERS



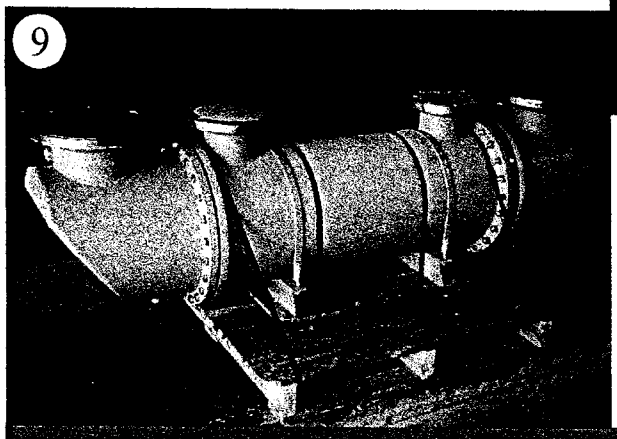
6. Carbon steel end bonnets being assembled.



7. Finalizing assembly.



8. Completed oil cooler is being pressure test.

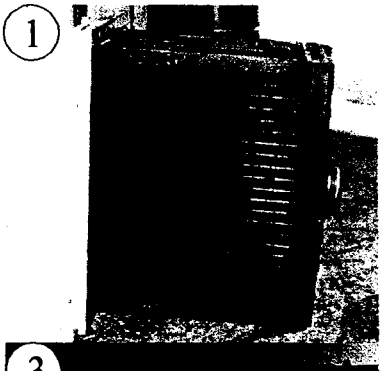


9. Oil cooler ready for delivery.

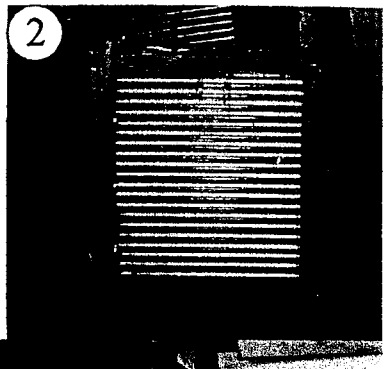
* 90/10 Copper/Nickel Tubes
* Navel Brass Tubesheets and Baffles
* Rolled Construction
* Carbon Steel and Stainless Steel Housings and End Bonnets
* Carbon Steel Parts Sandblasted and Subsea Coated
* Each Unit Equipped with Cathodic Protection.
* Deliveries on Large Heat Exchangers as soon as 1 week.
* Heat Exchangers Custom Built to Original Specifications. No Piping Changes Necessary.

INNERCOOLERS & AFTERCOOLERS

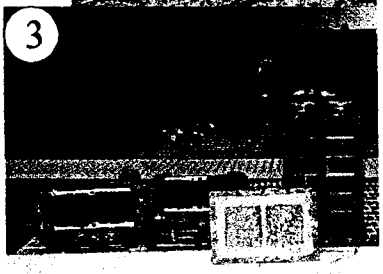
Service & Repair



1. Alco aftercooler before servicing.

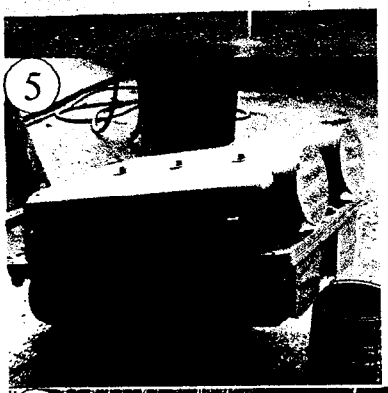


2. Alco aftercooler after having been disassembled, cleaned, repaired, pressure tested and painted.

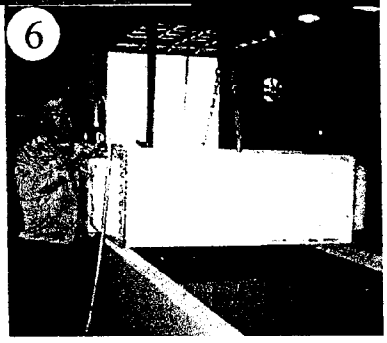


3. 12V71TI Detroit Diesel heat exchanger and innercooler before servicing.

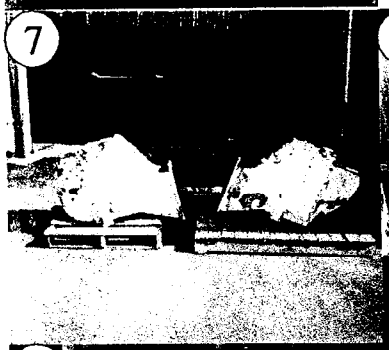
4. 12V71TI Detroit Diesel heat exchanger and innercooler after having been disassembled, cleaned, repaired, pressure tested and painted.

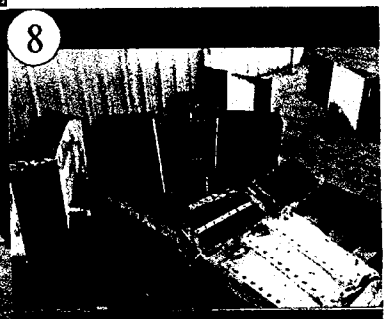


5. Caterpillar aftercooler in the process of being painted.

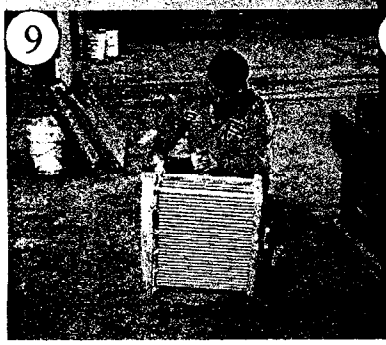


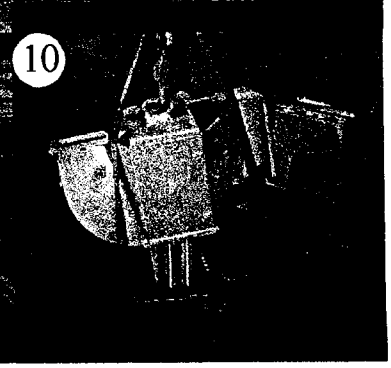
6. Large ship aftercooler in the pressure testing stage, after having been disassembled, cleaned and repaired.





7. EMD aftercooler before.
8. EMD aftercooler after having been disassembled.
9. EMD aftercooler being painted after reassembly, repairing, and pressure testing.
10. EMD in final stages of reassemblying.



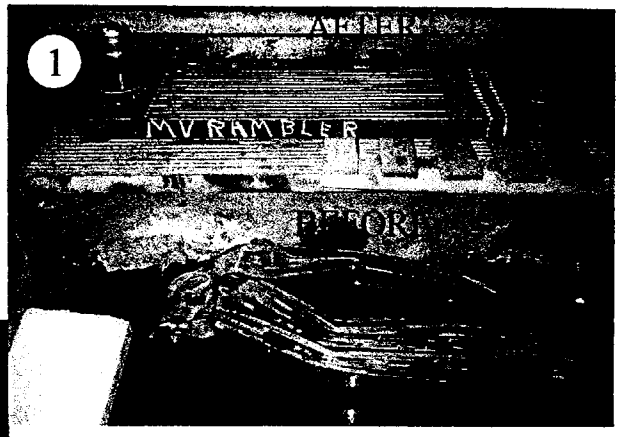


NOTE:

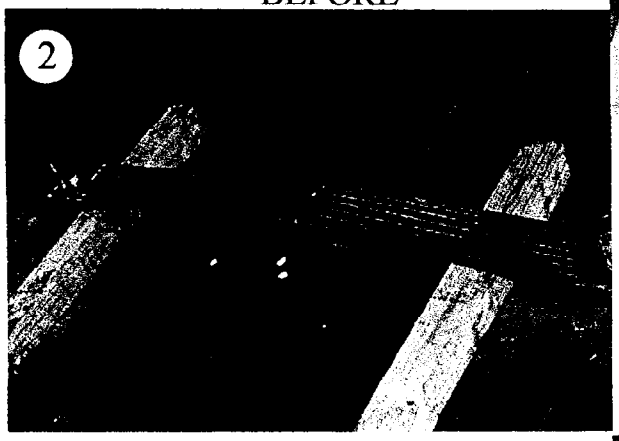
We have the capability to fabricate new Carbon Steel or Stainless Steel end bonnets as the need arises.

KEEL COOLERS
Service & Repair

1. Manifold and tube section replaced at a significant savings in cost, to the customer.

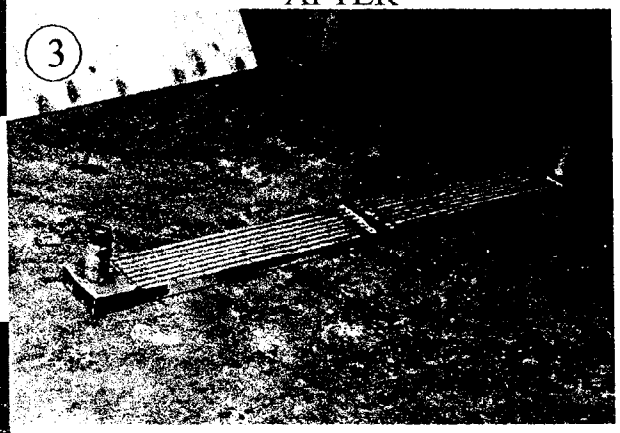


BEFORE



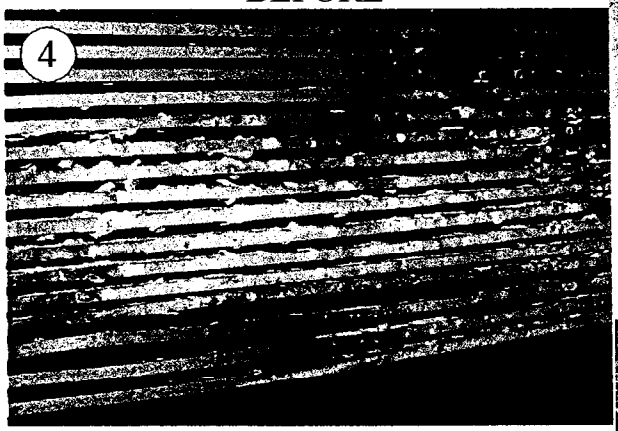
2. Keel cooler bent and damaged.

AFTER



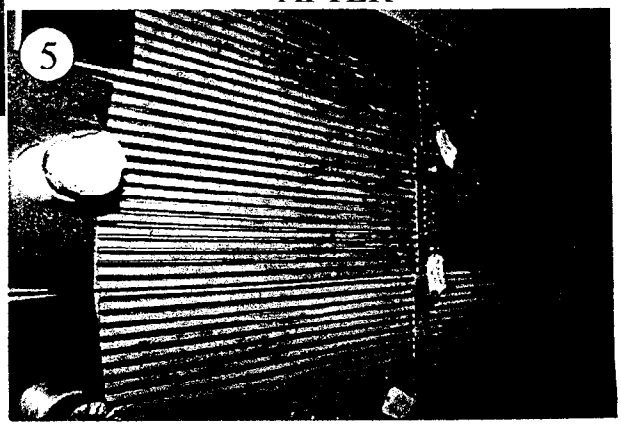
3. Keel cooler straightened and repaired.

BEFORE



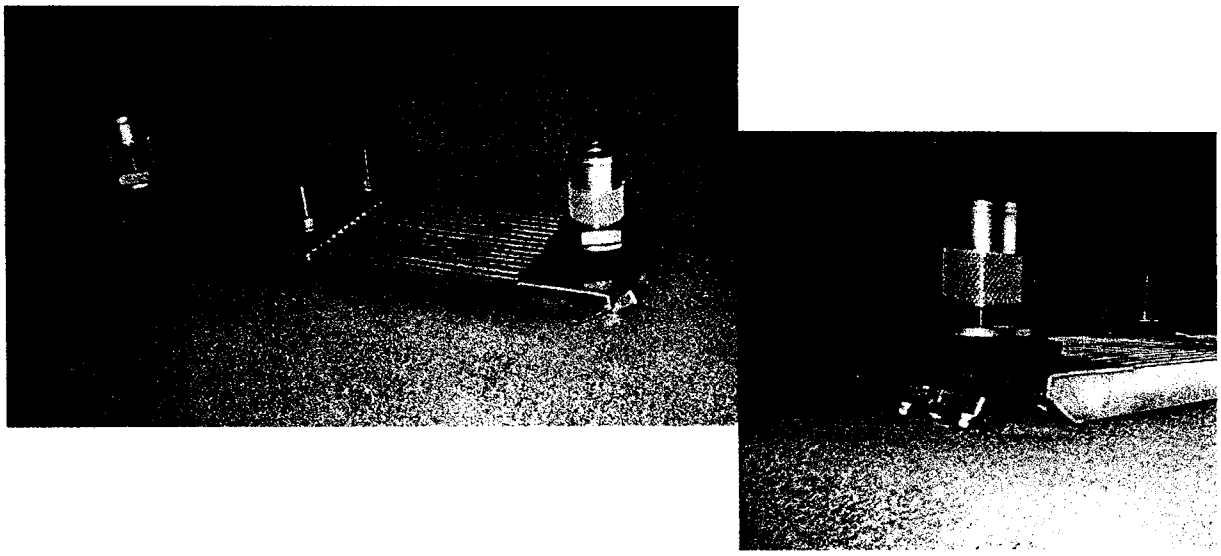
4. Keel cooler before cleaning.

AFTER



5. Keel cooler after being cleaned, repaired, threads reworked and replacement of gaskets and anodes.

KEEL COOLERS
Manufacturing



Welded Construction For Dependability & Durability.

Seamless 90/10 Copper-Nickel Rectangular Tubes
- With 0.070" Wall Thickness
- Exceptional Heat Transfer Properties
- Excellent Corrosion/Erosion Resistance To The Effects Of Sea Water.
- Exceptional Anti-Fouling Capabilities

Many Models Available - Interchangeable With Competition.

Each Unit Equipped With Cathodic Protection.

Before Delivery:
- Each Unit Is Assembled, Pressure Tested And Hydrostatically Tested

Full Scale Heat Transfer Dynamometer

Continued Research, Design And Testing Of Keel Coolers
- Example: Flange Mounted Keel Cooler To Be In Full Production Soon.

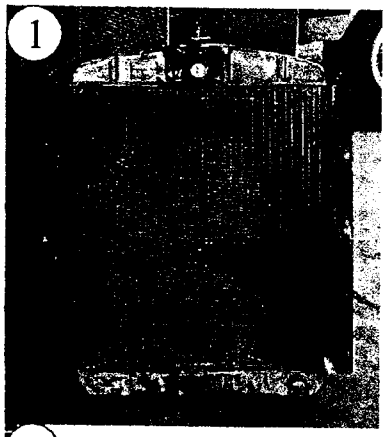
Redesigned Manifold To Improve Water Flow And Pressure Drops.

Full Line Of Replacement Parts In Stock,

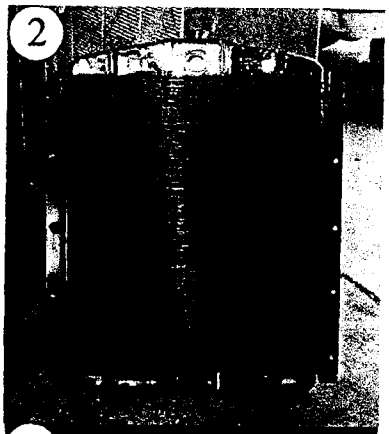
Services:
- 24 Hour Emergency Delivery Upon Request (Subject To Prior Sale).
- Clean & Repair Of All Makes Of Keel Coolers.

AUTOMOTIVE & INDUSTRIAL RADIATORS

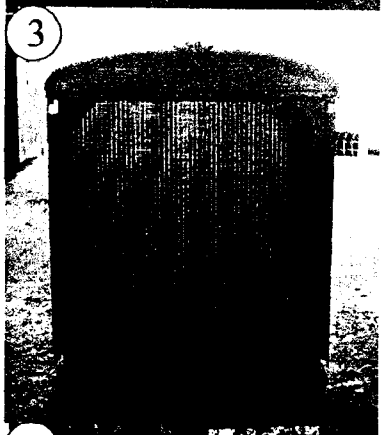
Sales & Service



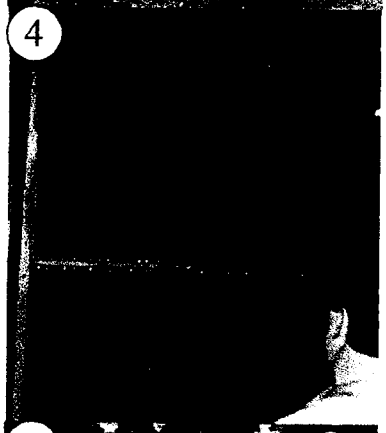
1. 671 Detroit Diesel Radiator before.



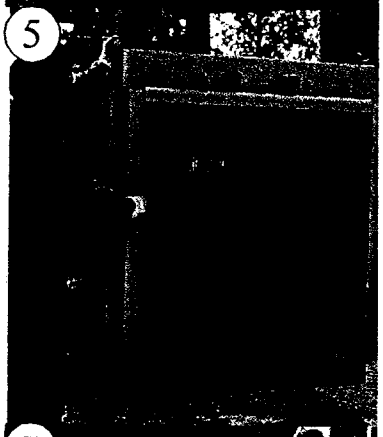
2. 671 Detroit Diesel Radiator after having been recored, side walls replaced and coppon coated.



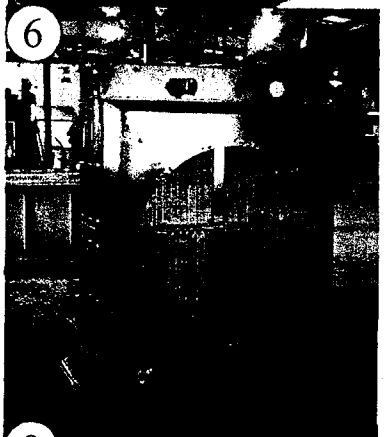
3. 8V71 Detroit Diesel recored radiator.
   Radiator has solder coated core. The tanks and side walls were sandblasted, primed and painted.



4. Six section radiator in the reassembly process. Cores are solder coated. The tanks and side walls were sand-blasted, primed and painted.

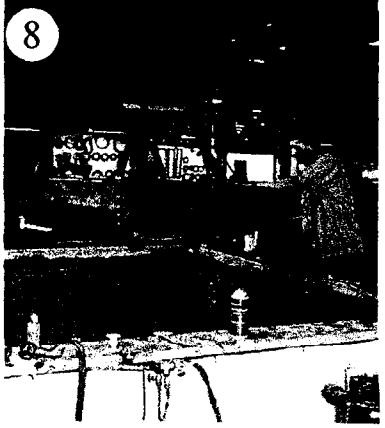


5. New Cummins radiator being loaded for delivery.



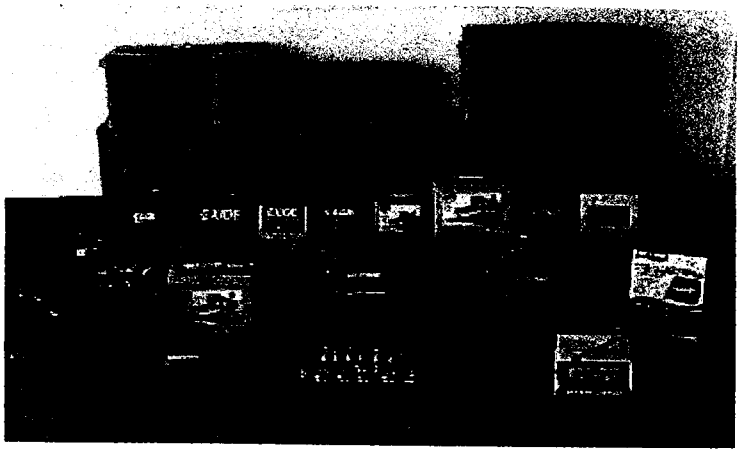
6. Four section radiator and aftercooler after having been recored with solder coated cores.

7. Radiator in the process of being repaired and sidewalls will be replaced.



8. Industrial radiator being prepared for pressure testing.

BATTERIES & ACCESSORIES



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Jeffersonville, Ind.

"Midland is a big, big cow to swallow," Horn said.

Midland will be a relatively smaller portion of KeySpan than it was of Eastern, said Raskin, whose future role with the company has yet to be decided.

Midland, which Eastern acquired in 1961, has a fleet of 2,300 barges and 87 towboats. It hauls mainly coal and other dry bulk cargoes. Midland employs approximately 1,300 people, about 44 percent of Eastern's total work force of 2,900.

For the nine months ended Sept. 30, Eastern's revenues totaled $660 million, with natural gas accounting for $452.4 million and the marine side $196.8 million.

Marine revenue rose $2.1 million from the year before, reflecting an improved export grain market and increased imports of ores and steel-related raw materials. But the increase was offset in part by lower demand from utilities for coal.

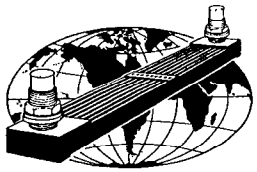
— Dale K. DuPont

Northwest shipyard lands Canadian partner

That their booths at the recent WorkBoat Northwest Show in Seattle were side by side was just a coincidence. Given their new relationship, however, the exhibition's juxtaposition of Vancouver Shipyards Co. Ltd. and Bellingham (Wash.) Bay Shipyard symbolized their new financial and working relationship.

Just prior to the show, officials from both companies agreed to an arrangement in which the Washington Marine Group (owners of Vancouver Shipyards, Vancouver Drydock Co., Victoria Shipyards Co. Ltd., Seaspan International, C.H. Cates & Sons Ltd. and many other commercial marine businesses in British Columbia) purchased 49 percent of Bellingham Bay Shipyard.

WHY BUY FERNSTRUM GRIDCOOLERS®



FERNSTRUM
ENGINEERED KEEL COOLING

Some manufacturers make statements about the superiority of their cooling systems as compared to the Fernstrum GRIDCOOLER. In this section, we would like to caution you about some of the misleading statements that may be made by our competitors.

FICTION: A GRIDCOOLER can't be used in high speed applications.

FACT: GRIDCOOLERS are currently being used on high speed crew and patrol craft. The GRIDCOOLER creates a negligible amount of drag in high speed applications, and their sturdy design will hold up under the most demanding conditions.

FICTION: A GRIDCOOLER must be mounted in a recess.

FACT: Any GRIDCOOLER may be mounted in a recess or just externally mounted on the side, bottom or rake of the hull, depending on the vessel design.

FICTION: GRIDCOOLERS require too many through hull fittings.

FACT: Any GRIDCOOLER can use our L-Series option which requires only two through hull fittings, one for the inlet nozzle and one for the outlet nozzle.

FICTION: The GRIDCOOLER is more difficult to plumb than our competitors' coolers.

FACT: The two-pass or U-Flow GRIDCOOLER has both inlet and outlet nozzles on the same end of the unit. The nozzles can use a variety of fasteners including hose connectors, flanges, or threaded pipe.

FICTION: Grooved round tubing is more efficient than smooth rectangular tubing.

FACT: This statement might be true, depending on the cross-sectional area and perimeter of the two tubes used in the comparison, but don't be misled into believing that the grooved tubing used by our competitors is more efficient than our tubing. Efficiency of the cooling units in question can be determined by simply comparing the

QUALITY — Our 100% parts inspection process and rigorous testing procedures insure that all raw material and every GRIDCOOLER is built with the same exacting standards that prompted the U.S. Navy to set their keel cooling standards by the Fernstrum GRIDCOOLER. Nearly 25% of the production time for every GRIDCOOLER is spent in inspection and testing, from raw material to finished product. This level of quality control insures the dependability and performance that has kept our GRIDCOOLERS in service for as long as 30 years.

MATERIALS — A standard series GRIDCOOLER is made of either heavy gauge 90/10 copper-nickel or 5000 series marine grade aluminum rectangular tubing. These alloys were chosen because of their resistance to salt water corrosion and their heat transfer abilities. The copper/nickel units are silver brazed, and the aluminum units are welded. These construction materials and methods provide a level of durability far above any kit cooler.

DURABILITY — While 70/30 copper/nickel is marginally more corrosion resistant than 90/10, its lower heat rejection abilities make it a relatively poor heat conductor when compared to 90/10. However, don't be fooled into believing a kit cooler is more corrosion resistant than a GRIDCOOLER. A kit cooler uses a very thin walled tube while our GRIDCOOLER uses a much thicker wall tube. This thicker wall tube, and our welded and brazed joints, led the U.S. Navy to give the Fernstrum GRIDCOOLER a 20 year rating.

CONSTRUCTION — Kit coolers use "O" rings and gaskets to hold their coolers together for a "tight" seal. Unlike a kit cooler, the welded and brazed construction of a GRIDCOOLER provides a solid cooler. Welded and brazed joint construction also eliminates the excess wear between vibrating tubes and fasteners that occurs with kit coolers. Sure, you can replace kit tubes a bit easier, but why should you have to replace tubes?

PRECISION — Every GRIDCOOLER is built out of high quality pipe and sheet stock, not cheap out-of-round and thread bare castings or plug-and-pray seals. This allows us to let you decide how your GRIDCOOLER will attach to your vessel; and have peace of mind in knowing it will attach properly.

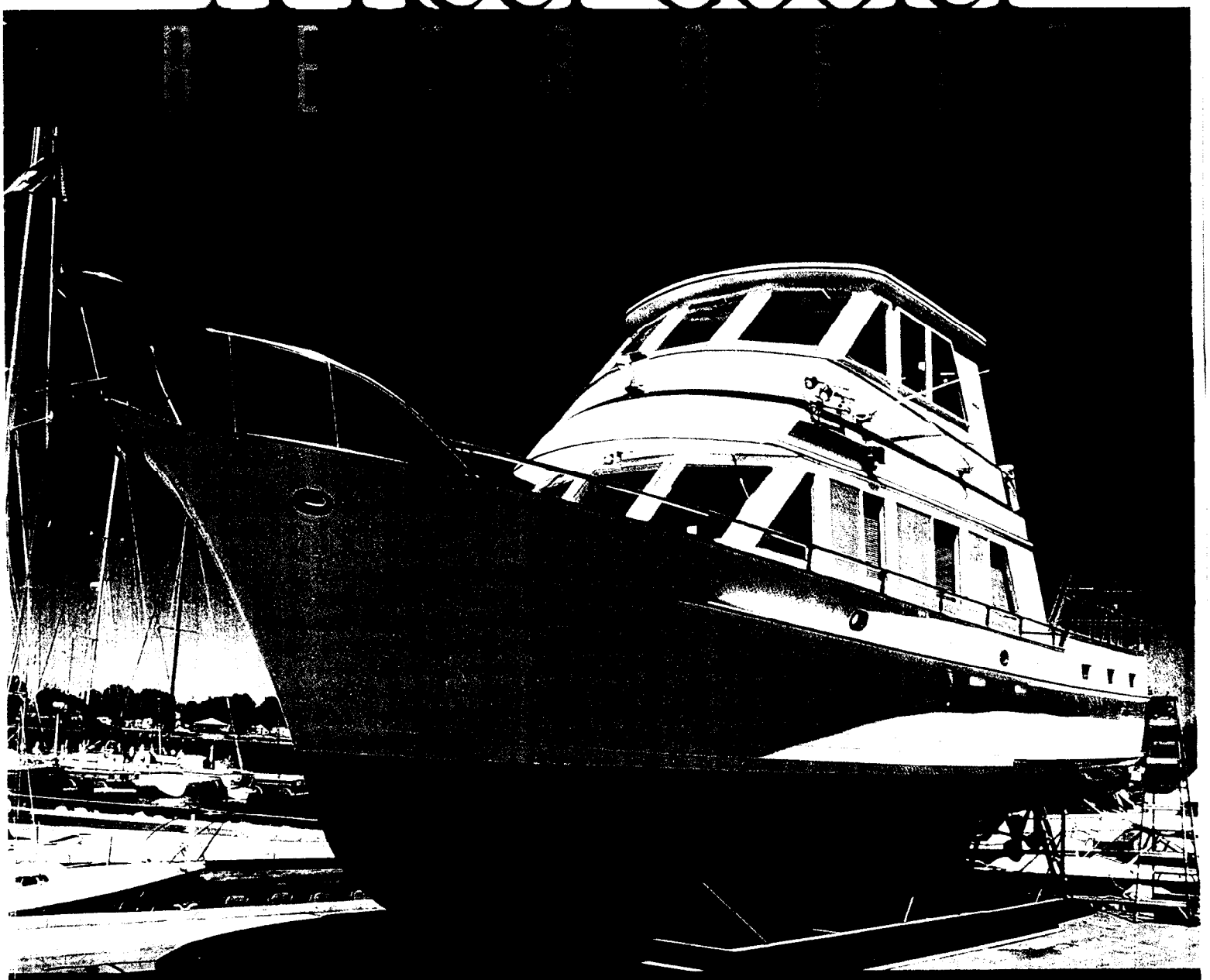
SIZE — The GRIDCOOLER is the most efficient keel cooler available. Our 90/10 copper/nickel has 1/3 more heat rejection ability than the 70/30 copper/nickel used by the competition. Our rectangular tube is much more efficient than the thin spiral round tube used by the competition. The size of our cooler can be easily compared to any of theirs. Based on the same information, our GRIDCOOLER can be as little as half the size of their bulky kit coolers.

PRESSURE DROP — Overheating, uneven engine cooling and air pockets in the cooling system are just a few of the problems associated with excessive pressure drop in an engine cooling system. Any one of these problems will cause premature engine wear and engine failure if the problem is not addressed. It also limits the types of pumps that can be used for coolant flow. Unlike the kit coolers you may see, our GRIDCOOLER is designed to create a minimum amount of pressure drop. Kit coolers using spiral tube create turbulence and turbulence is pressure drop. Kit coolers with only one through hull fitting severely restrict water flow, which creates pressure drop.

Reprinted from Winter 9

PassageMaker™
THE TRAWLER & OCEAN MOTORBOAT MAGAZINE

A Keel Cooler



Keel Cooling An Island Gypsy 44 Motoryacht.

by Bill Parlatore
photography by the author

Left: Custom flybridge on *American Dream*. Above: Flybridge helm station is well protected, and the additional room is great for family cruising.

A New Boat

A Perfect Opportunity

On The Shores Of Green Bay

Maintenance. The twenty-two employees of Fernstrum build coolers for all kinds of vessels and applications, most of them destined for the commercial and fishing fleets. I saw large coolers, small coolers, bright new coolers made out of aluminum, and a couple of huge coolers being packed in wood cases destined for ferry boat service.

I learned these guys make keel coolers one at a time, and the process is fascinating to watch. Each one is carefully handmade, almost a work of art – which is a real shame as it spends its entire life underwater, out of sight.

Plan The Work

Paul explained that *American Dream* would get two keel coolers for the main engines, each comprised of twelve tubes 60 inches long. The model designation, B1260B, explains the size and configuration. The coolers would be installed below the engines on each side of the lower hull, located just up from the keel so as to simplify plumbing runs. (By way of comparison, a Cat 210 hp 3208NA would use a B1245B cooler, which is twelve tubes 45 inches long. The B1245B model would also work for a Trigger Island 38.)

To handle its air conditioning cooling requirement, the Island Gypsy would be fit with the prototype Smartcooler, sized to handle the combined needs of the three air conditioning units. It was also rated for zero water flow past the cooler, so it would be large enough to work at anchor or at the dock. The decision was made to mount the Smartcooler just below the waterline under the teak swim platform on the transom.

Paul's son Sean Fernstrum explained that the most difficult part of this project was having to deal with older Volvo engines, which required different thermostat housings and adapters to fit the necessary hoses. While off the shelf adapters are readily available for Cats, Cummins, Lehmans, and Caggers, these particular Volvo engines are just not as common.

Work The Plan

"Each installation is unique," Sean told me. "And it's important to plan the entire job very carefully.

Building the keel cooler

The individual tubes are assembled using silver solder, skillfuly done by craftsman with years of experience.

Pressure testing a new keel cooler in water tank. Compressed air is pumped into the submerged cooler.

Hot water and steam clean out solder rosin and impurities from new keel cooler before shipping to customer.

But if you do your homework, it all comes together quickly and without problems."

The plan was simple. Each engine would get its own Gridcooler (Fernstrum's name for their product line), and the new cooling system would be connected as a simple circuit. Coolant exiting the engine block would run down a short length of hose to the forward intake nozzle of the 90 inch long keel cooler.

The coolant would travel the length of the keel cooler's tubes, surrounded by sea water. The now cold coolant would exit the exhaust nozzle of the cooler, through hose connected to the gear cooler on the marine transmission.

From there, coolant next runs through the engine's lube oil cooler (located on the side of the Volvo block), and finally back to the engine at the intake of the engine's water pump, completing the circuit.

Paul chose to keep the Island Gypsy's wet exhausts rather than converting them to some form of dry exhaust system, so the existing raw water through hull and strainer would remain. They would be used to handle the wet exhaust, as well as the water-lubricated stuffing box.

The adapter pieces took some time to locate for the Volvo engines, and it became necessary to fabricate new thermostat housings, as none were available for 18-year-old TAMD60B engines.

Walking The Production Floor

Fernstrum's coolers are constructed entirely of copper-nickel (90% copper, 10% nickel). A 5000-series marine grade aluminum cooler is also available for use on unpainted aluminum work boats, but most keel coolers are copper-nickel.

As we watched a man brazing together the end of a new keel cooler, Sean explained that they use silver solder to put these units together. With a content of 50% silver, the rolls of solder are expensive, but make for a permanent and trouble-free assembly. (The next week's supply of solder was delivered while I was there. Four rolls were just enough for a week of production—a total of 1,000 feet of solder. Hmmm...that's 2,000 troy ounces at about $5 a troy ounce. That's some expensive solder!)

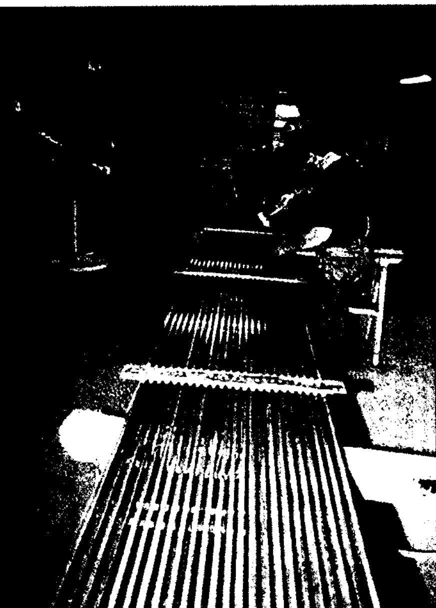
After assembly, each cooler is pressure tested in a water tank to check for leaks, then it is steam cleaned to remove any rosin or debris from inside the tubes. Any subtle bends are also hammered out before the coolers are crated for shipping.

American Dream sat on her cradle in the boat yard when we drove over to check on progress. A man from the yard was busy glassing in some fairing blocks to the hull, to protect the ends of the coolers that were being bolted in place. The port side cooler had just been installed, although they had not yet hooked up the connecting hoses.

It was all pretty straight forward, except perhaps getting the proper twist in the cooler to match the shape of the hull.

The Smartcooler

Paul and son Todd Fernstrum next prepared the



Rubber mallet is used to straighten any bends from construction process. This large cooler is for commercial vessel.

Completed cooler is carefully crated for worldwide shipping. This handmade keel cooler will easily outlast the boat.

types set for the Smartcooler. Using a paper template resembling the cooler's nozzle and stud holes, they carefully measured where they needed to drill into the transom. Ever so carefully, Todd then drilled a pilot hole in the center of each location, following it with a hole saw to complete the job.

Unfortunately, as he drilled the first couple of holes, water came pouring out—enough to make us stand back and watch in amazement. Clearly, the ¾-inch plywood between the inner and outer layers of fiberglass was saturated with water, and the trapped water now ran out. Not good. Another project was taking shape.

We took the cooler back to the shop to put in the proper bend on the transom-mounted cooler. It went on easily once we got the right shape.

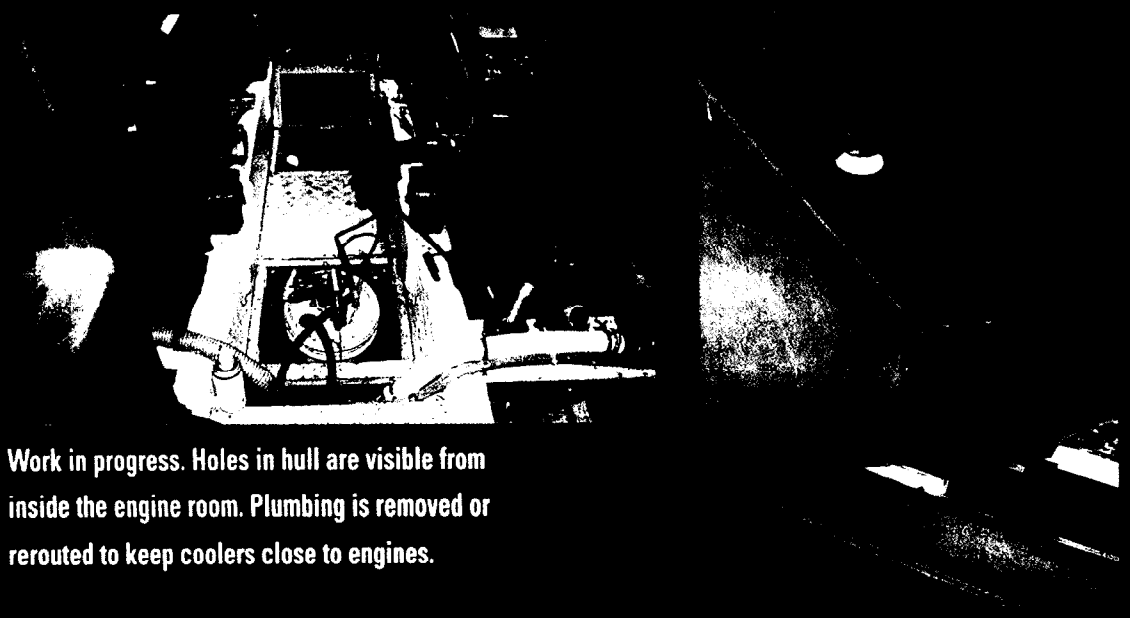
Beyond the simple task of attaching hoses and clamps to the main engines and the air conditioning condensers, the next stage was to get rid of air pockets when filling the systems with 50/50 antifreeze/water. Paul Fernstrum mentioned that they tried to avoid creating unnecessary high spots that would trap air. But he assured me there is always a way to purge these air pockets, even if it takes some frustrating moments to get them all.

But then you're ready to go!

A Picture Worth A Thousand Words

As you can see from the pictures, the project isn't difficult, and makes for a reliable and care-free cooling system when done correctly. In the case of the air conditioning systems on *American Dream*, there are no underwater or waterline through hulls to clog with grass or jellyfish, and there won't be that annoying dribble of water to disturb a sleeping crew. Even tied to a dock with no current or tidal action, the Smartcooler will

Installing the engine keel cooler

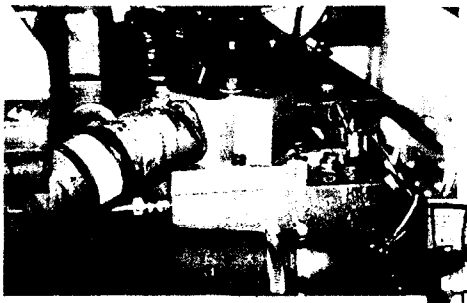


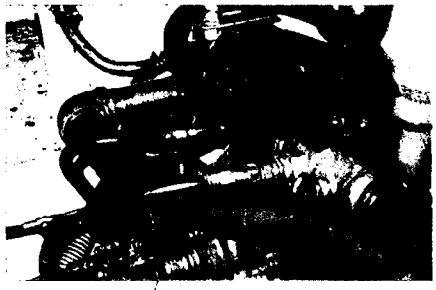
Work in progress. Holes in hull are visible from inside the engine room. Plumbing is removed or rerouted to keep coolers close to engines.

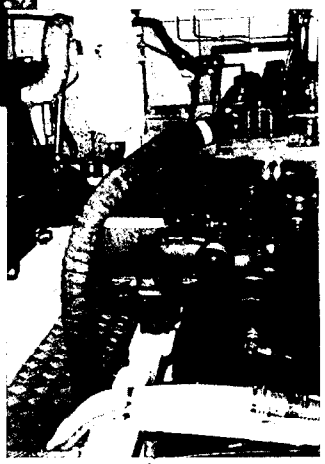
Two 2½" holes drilled on starboard side of American Dream for cooler nozzles. One-inch holes are for the studs that bolt cooler to backing plates

Far Left: Fairing blocks are glassed on hull to protect keel cooler and minimize drag.
Left: Now, some sanding and paint for the blocks.

Keel Cooling for Volvo







THERMOSTAT

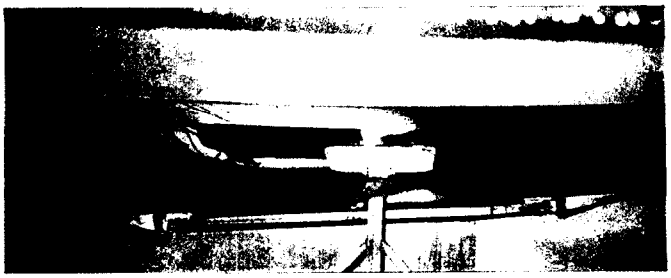
GEAR COOLER

ENGINE

PUMP

OIL COOLER

GRID COOLER



prove large enough to keep the air conditioning working. Quietly.

I also didn't notice the stress normally associated with boat projects. Maybe that is because much of the work is outside the hull, or maybe it is just a result of careful planning. Either way, fitting a keel cooler on a boat is not a major undertaking.

There You Have It

Problems in cooling systems are the most common type of maintenance and repair activity in the engine room. Adding a keel cooler can improve overall reliability of key systems, not just the main engines, and should be a consideration when you work towards your ideal passagemaker.

American Dream is now enjoying her new life on Green Bay and Lake Michigan. And as she gets more miles under her keel, the crew can sit up on her comfortable, enclosed flybridge and be confident they've made her even better.

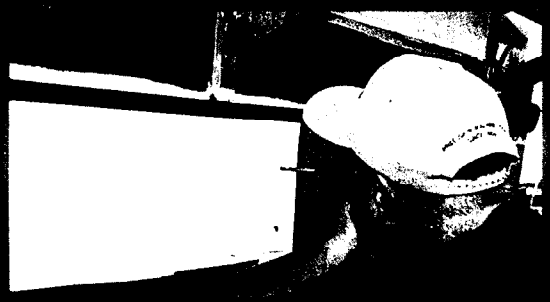
The folks at Fernstrum are real craftsmen in a decidedly niche business, although they are well known in the commercial and fishing industries. Fernstrum coolers are on boats around the world, each one handcrafted in the heart of America.

Retrofit or new construction, keel cooling is another element in the continuing saga of finding ways to make a bulletproof engine room.

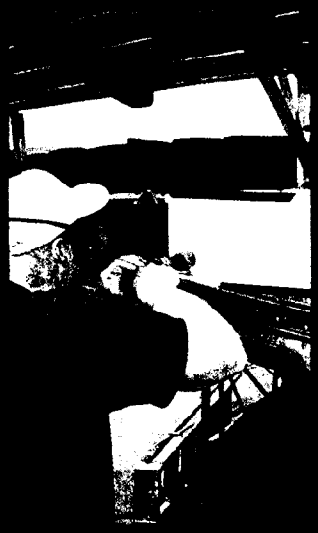
And now, it seems, they're not just for engines anymore. ●

Now for the Smartcooler

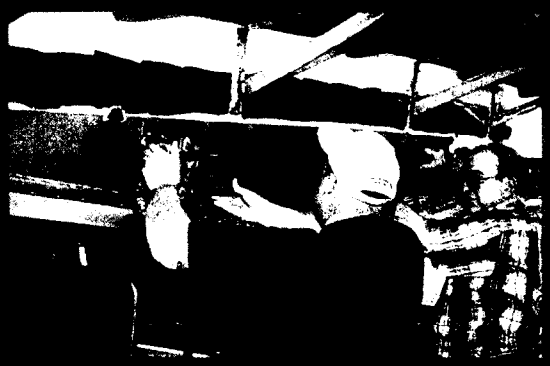
Paul and Todd Fernstrum attach paper template.



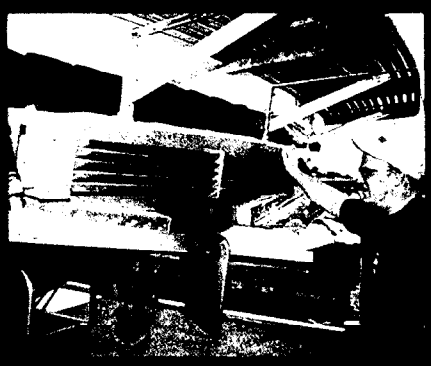
Using the Smartcooler template as guide, Todd drills pilot holes. Getting them right is vital. (Note water coming out of lower hole in transom.)



Todd next drills larger holes for cooler nozzles.



Initial fitting shows need for slight bend in the cooler to better follow the curve of the transom, allowing the nozzles to exactly match holes.



Left: Back at the shop, a press makes light work of bending the Smartcooler. Above: The Smartcooler fits great!

The Cost of Installing Keel Cooling On American Dream:

The following costs represent what is actually needed to complete this project on this particular Island Gypsy 44 Motoryacht. It is a good reference for such a project on another boat, although keep in mind that all shown costs are for doing this job on an older Volvo TADM60B diesel.
The left-hand column reflects Paul Fernstrum's actual costs; the right column is useful to show what can be expected if you do this work yourself.

The additional figures for the Smartcooler installation are listed at the bottom. These numbers should give you a good idea of what this investment costs, and provide you a starting point for thinking keel cooling for your own boat. How much is this security worth?

Materials	American Dream	Do It Yourself
Gridcooler Model BX1260B-E1-S1	$2,267.00	$2,267.00
twelve feet of 2-inch hose	82.80	82.80
twelve feet of 1-inch hose	42.96	42.86
ten 2-inch hose clamps	18.89	18.89
six 1-inch hose clamps	7.74	7.74
thermostat cover	120.00	120.00
thermostat housing**	1,553.00	300.00
gear oil cooler	342.00	342.00
two 2-inch lube oil covers**	544.00	45.00
four 2-inch elbows	36.00	36.00
two 2-inch hose barbs	12.00	12.00
misc. bushings, gaskets, O-rings, flare connectors	72.45	72.45
five gallons antifreeze	34.95	34.95
one quart transmission oil	1.75	1.75
17.5 hours labor	1,050.00	-
Fairing Blocks:		
material	207.14	207.14
13.6 hours labor	680.00	-
Total Per Engine	$7,072.68	$3,590.68

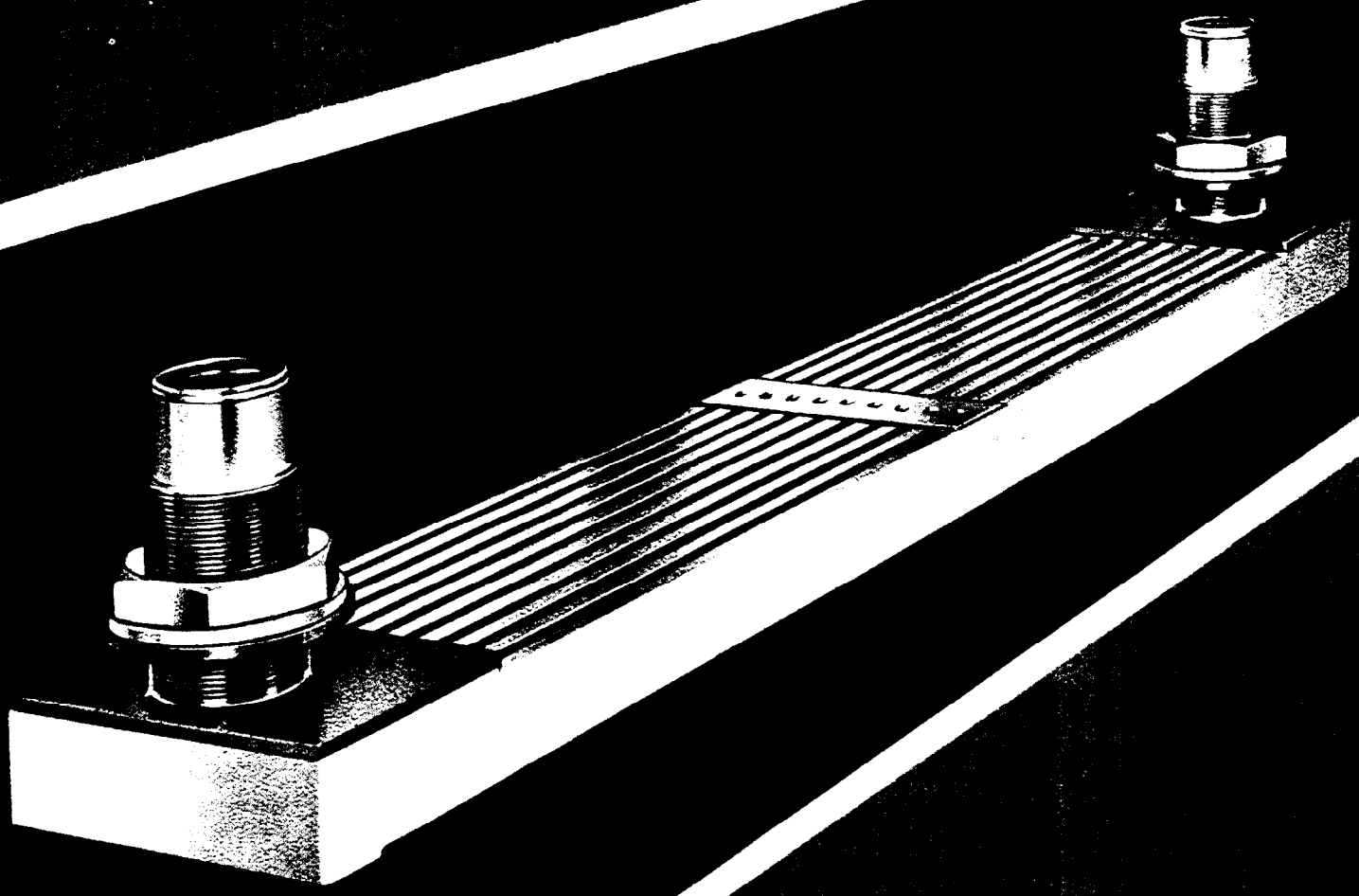
***These very expensive Volvo dealer parts could have easily been fabricated in the Fernstrum shop, and do-it-yourself pricing indicates cost for local machine shop fabrication.*

Smartcooler Model DBXS1060U***	$1,395.00	$1,395.00
expansion tank	39.70	39.70
3.0 hours labor installation	150.00	-
1 hour labor - fabrication of expansion tank	50.00	50.00
Total	$1,634.70	$1,434.70

****Sized for 30,000 Btu air conditioning. The costs do not include the short length of hose and hose clamps for connecting the Smartcooler and expansion tank to the circulating pumps of the air conditioning units.*

CATALOG
970

GRIDCOOLER



ENGINEERED KEEL COOLING

FERNSTRUM GRIDCOOLER

THE MODERN WAY TO COOL YOUR MARINE ENGINE

The GRIDCOOLER

The GRIDCOOLER

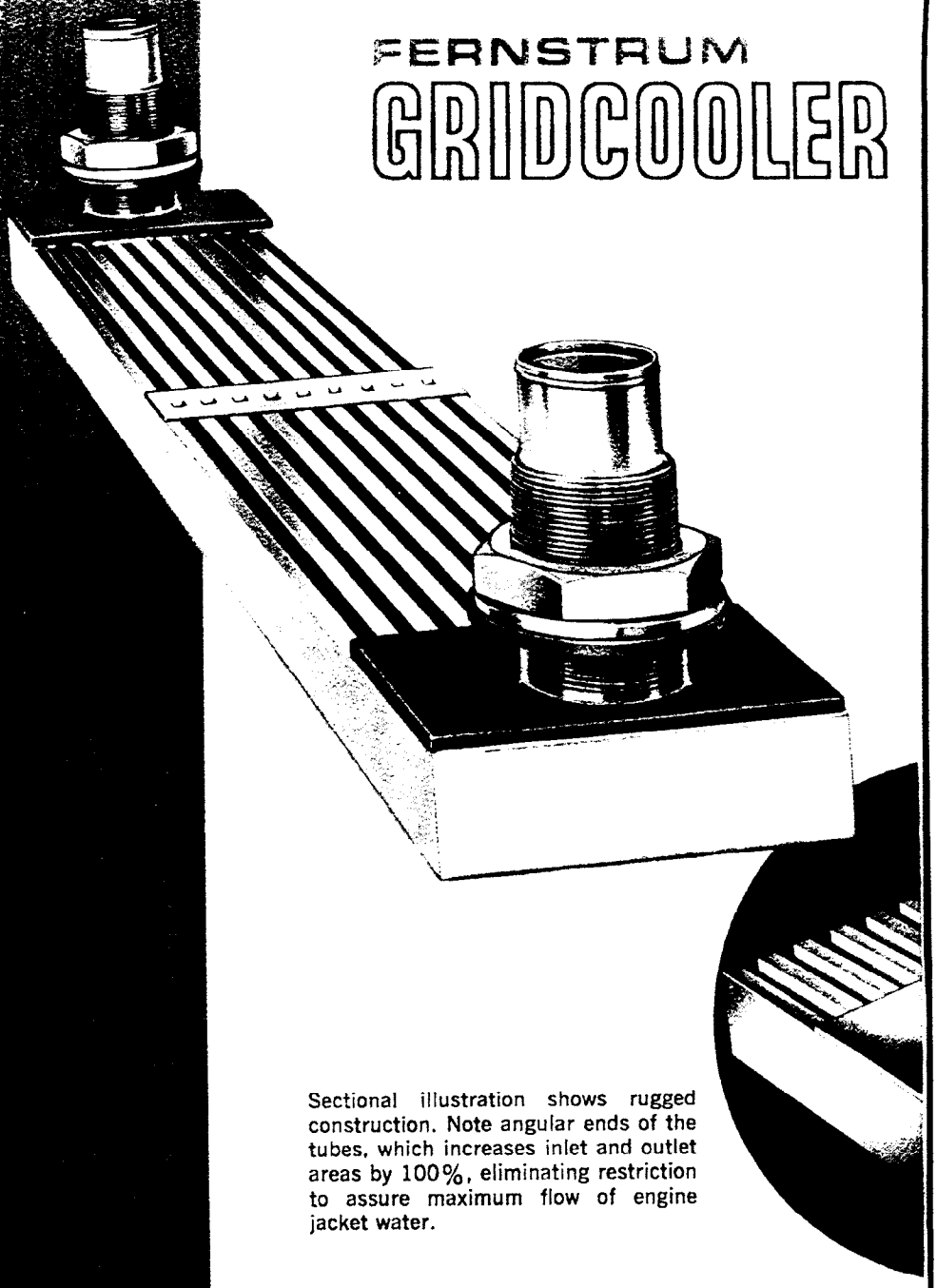
The GRIDCOOLER's

GRIDCOOLERS

GRIDCOOLERS

MATERIALS

TIME TESTED AND PROVEN



Sectional illustration shows rugged construction. Note angular ends of the tubes, which increases inlet and outlet areas by 100%, eliminating restriction to assure maximum flow of engine jacket water.

The GRIDCOOLER

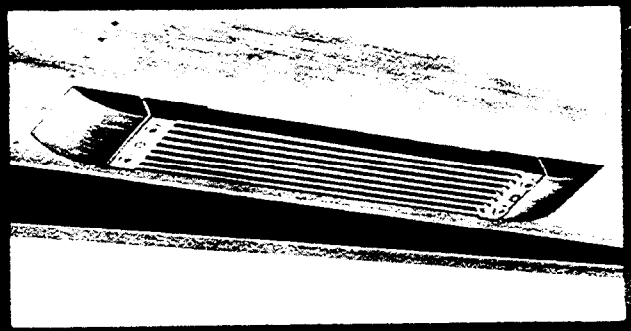
EASILY INSTALLED

FOUL PROOF

STREAMLINED

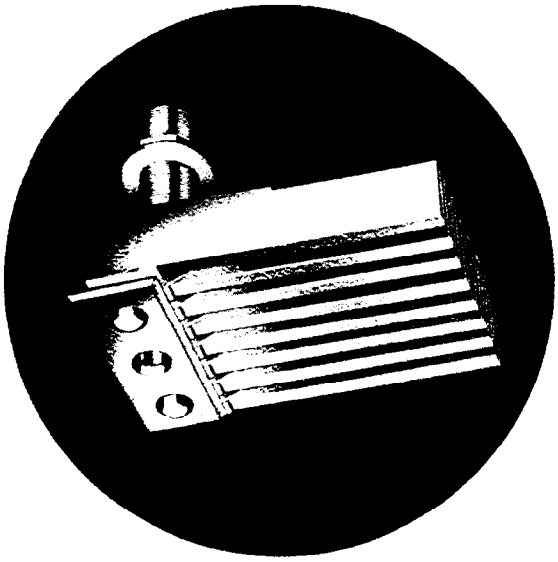
PRESSURE DROP

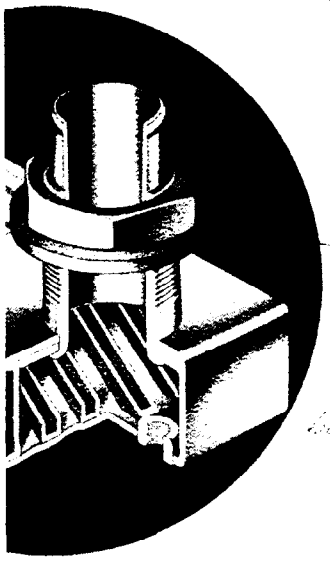
SEAWORTHY



External type installation. Fairing blocks as shown are used at each end of GRIDCOOLER for protection and streamlining.

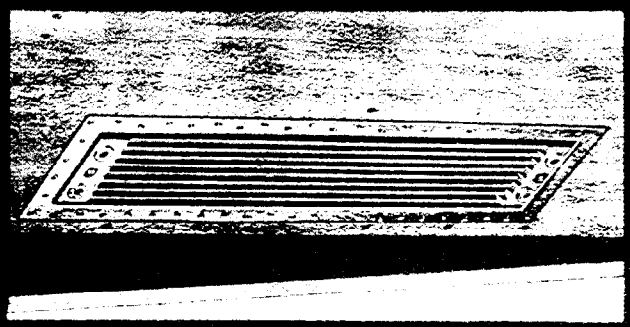
. . THE SIMPLEST AND MOST DEPENDABLE
FORM OF FRESH WATER COOLING





This illustration shows mounting of replaceable zinc electrode plate to headers. Minimizes galvanic corrosion in sea water operation. Furnished as standard equipment on sea water coolers.

A GOOD ENGINE
NEEDS GRIDCOOLER
PROTECTION



Flush type installation for maximum protection. Unit is recessed within hull line, with no loss in heat transfer capacity.

GRIDCOOLER INSTALLATION DIMENSIONS

SINGLE

MODEL	A	B	C	D	E	F	G	H
B624B	24	27		3 15/16	3 1/2	1 3/4	1 1/2	1 1/2
B630B	30	33		3 15/16	3 1/2	1 3/4	1 1/2	1 1/2
B636B	36	39		3 15/16	3 1/2	1 3/4	1 1/2	1 1/2
B642B	42	45	21	3 15/16	3 1/2	1 3/4	1 1/2	1 1/2
B648B	48	51	24	3 15/16	3 1/2	1 3/4	1 1/2	1 1/2
B824B	24	27		5 3/8	3 1/2	1 3/4	1 1/2	1 1/2
B830B	30	33		5 3/8	3 1/2	1 3/4	1 1/2	1 1/2
B836B	36	39		5 3/8	3 1/2	1 3/4	1 1/2	1 1/2
B842B	42	45		5 3/8	3 1/2	1 3/4	1 1/2	1 1/2
B848B	48	51	24	5 3/8	3 1/2	1 3/4	1 1/2	1 1/2
B854B	54	57	27	5 3/8	3 1/2	1 3/4	1 1/2	1 1/2
B860B	60	63	30	5 3/8	3 1/2	1 3/4	1 1/2	1 1/2
B866B	66	69	33	5 3/8	3 1/2	1 3/4	1 1/2	1 1/2
C630C	30	33 1/2		5 5/16	4	1 15/16	2	2
C636C	36	39 1/2		5 5/16	4	1 15/16	2	2
C642C	42	45 1/2		5 5/16	4	1 15/16	2	2
C648C	48	51 1/2	24	5 5/16	4	1 15/16	2	2
C654C	54	57 1/2	27	5 5/16	4	1 15/16	2	2
C660C	60	63 1/2	30	5 5/16	4	1 15/16	2	2
C830C	30	33 1/2		7 1/16	4	1 15/16	2	2
C836C	36	39 1/2		7 1/16	4	1 15/16	2	2
C842C	42	45 1/2		7 1/16	4	1 15/16	2	2
C848C	48	51 1/2		7 1/16	4	1 15/16	2	2
C854C	54	57 1/2	27	7 1/16	4	1 15/16	2	2
C860C	60	63 1/2	30	7 1/16	4	1 15/16	2	2
C866C	66	69 1/2	33	7 1/16	4	1 15/16	2	2
C872C	72	75 1/2	36	7 1/16	4	1 15/16	2	2
C878C	78	81 1/2	39	7 1/16	4	1 15/16	2	2
C884C	84	87 1/2	42	7 1/16	4	1 15/16	2	2
D830	30	36		7 1/16	5	2 3/4	2 1/2	2 1/2
D836	36	42		7 1/16	5	2 3/4	2 1/2	2 1/2
D842	42	48		7 1/16	5	2 3/4	2 1/2	2 1/2
D848	48	54		7 1/16	5	2 3/4	2 1/2	2 1/2
D854	54	60		7 1/16	5	2 3/4	2 1/2	2 1/2
D860	60	66		7 1/16	5	2 3/4	2 1/2	2 1/2
D866	66	72	33	7 1/16	5	2 3/4	2 1/2	2 1/2
D872	72	78	36	7 1/16	5	2 3/4	2 1/2	2 1/2
D878	78	84	39	7 1/16	5	2 3/4	2 1/2	2 1/2
D884	84	90	42	7 1/16	5	2 3/4	2 1/2	2 1/2
D890	90	96	30†	7 1/16	5	2 3/4	2 1/2	2 1/2
D896	96	102	32†	7 1/16	5	2 3/4	2 1/2	2 1/2
D1030	30	36 1/4		8 15/16	5	2 3/4	3	3
D1036	36	42 3/4		8 15/16	5	2 3/4	3	3
D1042	42	48 3/4		8 15/16	5	2 3/4	3	3
D1048	48	54 3/4		8 15/16	5	2 3/4	3	3
D1054	54	60 3/4		8 15/16	5	2 3/4	3	3
D1060	60	66 3/4		8 15/16	5	2 3/4	3	3
D1066	66	72 3/4	33	8 15/16	5	2 3/4	3	3
D1072	72	78 3/4	36	8 15/16	5	2 3/4	3	3
D1078	78	84 3/4	39	8 15/16	5	2 3/4	3	3
D1084	84	90 3/4	42	8 15/16	5	2 3/4	3	3

FERNSTRUM GRIDCOOLERS ARE C

E PASS

MODEL	A	B	C	D	E	F	G	H
D1090	90	96 1/2	30†	8 5/16	5	2 3/4	3	3
D1096	96	102 1/2	32†	8 5/16	5	2 3/4	3	3
D10102	102	108 1/4	34†	8 5/16	5	2 3/4	3	3
D10108	108	114 1/2	36†	8 5/16	5	2 3/4	3	3
D10114	114	120 1/4	38†	8 5/16	5	2 3/4	3	3
D10120	120	126 1/2	40†	8 5/16	5	2 3/4	3	3
D1230	30	36 1/2		10 5/16	5	2 3/4	3	3
D1236	36	42 1/4		10 5/16	5	2 3/4	3	3
D1242	42	48 1/2		10 5/16	5	2 3/4	3	3
D1248	48	54 1/4		10 5/16	5	2 3/4	3	3
D1254	54	60 1/2		10 5/16	5	2 3/4	3	3
D1260	60	66 1/4		10 5/16	5	2 3/4	3	3
D1266	66	72 3/4	33	10 5/16	5	2 3/4	3	3
D1272	72	78 1/4	36	10 5/16	5	2 3/4	3	3
D1278	78	84 1/4	39	10 5/16	5	2 3/4	3	3
D1284	84	90 1/2	42	10 5/16	5	2 3/4	3	3
D1290	90	96 1/4	30†	10 5/16	5	2 3/4	3	3
D1296	96	102 1/4	32†	10 5/16	5	2 3/4	3	3
D12102	102	108 1/4	34†	10 5/16	5	2 3/4	3	3
D12108	108	114 1/4	36†	10 5/16	5	2 3/4	3	3
D12114	114	120 1/4	38†	10 5/16	5	2 3/4	3	3
D12120	120	126 1/4	40†	10 5/16	5	2 3/4	3	3
D1630	30	37 1/4		14 5/16	5	2 3/4	3 1/2	3 1/2
D1636	36	43 1/4		14 5/16	5	2 3/4	3 1/2	3 1/2
D1642	42	49 1/4		14 5/16	5	2 3/4	3 1/2	3 1/2
D1648	48	55 1/4		14 5/16	5	2 3/4	3 1/2	3 1/2
D1654	54	61 1/4		14 5/16	5	2 3/4	3 1/2	3 1/2
D1660	60	67 1/4		14 5/16	5	2 3/4	3 1/2	3 1/2
D1666	66	73 1/4	33	14 5/16	5	2 3/4	3 1/2	3 1/2
D1672	72	79 1/4	36	14 5/16	5	2 3/4	3 1/2	3 1/2
D1678	78	85 1/4	39	14 5/16	5	2 3/4	3 1/2	3 1/2
D1684	84	91 1/4	42	14 5/16	5	2 3/4	3 1/2	3 1/2
D1690	90	97 1/4	45	14 5/16	5	2 3/4	3 1/2	3 1/2
D1696	96	103 1/4	32†	14 5/16	5	2 3/4	3 1/2	3 1/2
D16102	102	109 1/4	34†	14 5/16	5	2 3/4	3 1/2	3 1/2
D16108	108	115 1/4	36†	14 5/16	5	2 3/4	3 1/2	3 1/2
D16114	114	121 1/4	38†	14 5/16	5	2 3/4	3 1/2	3 1/2
D16120	120	127 1/4	40†	14 5/16	5	2 3/4	3 1/2	3 1/2
D16132	132	139 1/4	44†	14 5/16	5	2 3/4	3 1/2	3 1/2
D16144	144	151 1/4	48†	14 5/16	5	2 3/4	3 1/2	3 1/2
D16156	156	163 1/4	52†	14 5/16	5	2 3/4	3 1/2	3 1/2
D16168	168	175 1/4	42‡	14 5/16	5	2 3/4	3 1/2	3 1/2
D16180	180	187 1/4	45‡	14 5/16	5	2 3/4	3 1/2	3 1/2

Dimensions In Inches

† Two Intermediate Support Plates

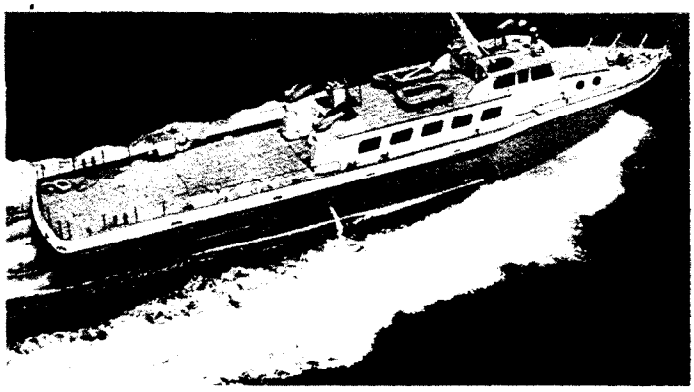
‡ Three Intermediate Support Plates

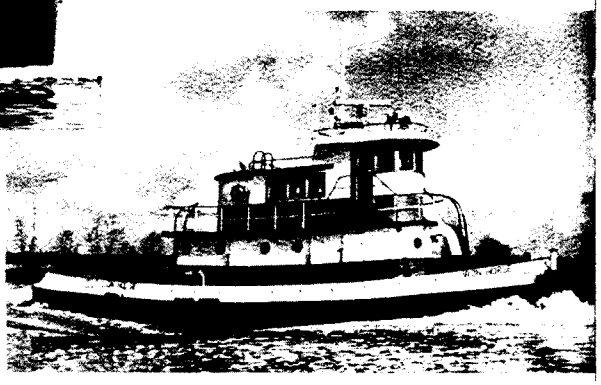
Specifications Subject To Change Without Notice

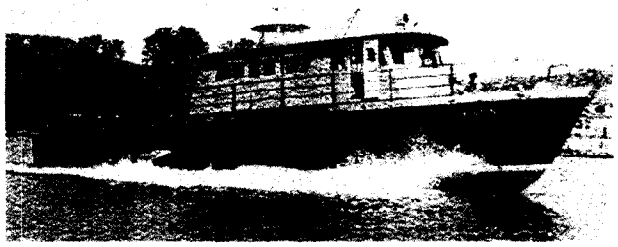
TWO PASS

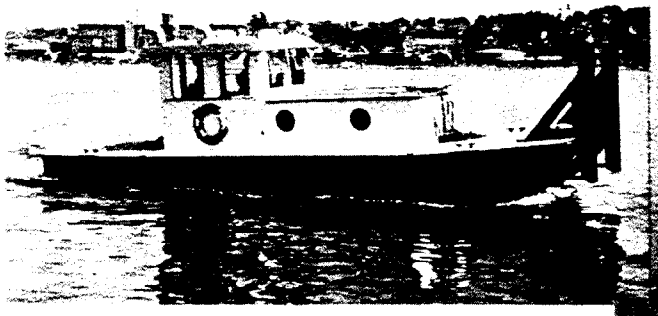
MODEL	A	B	C	D	E	F	G	H
B824U	24	27		5 1/8	3 1/2	1 3/4	1	1
B830U	30	33		5 1/8	3 1/2	1 3/4	1	1
B836U	36	39		5 1/8	3 1/2	1 3/4	1	1
B842U	42	45		5 1/8	3 1/2	1 3/4	1	1
B848U	48	51	24	5 1/8	3 1/2	1 3/4	1	1
B854U	54	57	27	5 1/8	3 1/2	1 3/4	1	1
B860U	60	63	30	5 1/8	3 1/2	1 3/4	1	1
B866U	66	69	33	5 1/8	3 1/2	1 3/4	1	1
C830U	30	33 1/2		7 5/16	3 1/2	1 15/16	1 1/2	1 1/2
C836U	36	39 1/2		7 5/16	3 1/2	1 15/16	1 1/2	1 1/2
C842U	42	45 1/2		7 5/16	3 1/2	1 15/16	1 1/2	1 1/2
C848U	48	51 1/2		7 5/16	3 1/2	1 15/16	1 1/2	1 1/2
C854U	54	57 1/2	27	7 5/16	3 1/2	1 15/16	1 1/2	1 1/2
C860U	60	63 1/2	30	7 5/16	3 1/2	1 15/16	1 1/2	1 1/2
C866U	66	69 1/2	33	7 5/16	3 1/2	1 15/16	1 1/2	1 1/2
C872U	72	75 1/2	36	7 5/16	3 1/2	1 15/16	1 1/2	1 1/2
C878U	78	81 1/2	39	7 5/16	3 1/2	1 15/16	1 1/2	1 1/2
C884U	84	87 1/2	42	7 5/16	3 1/2	1 15/16	1 1/2	1 1/2
D1030U	30	36 3/4		8 15/16	4	2 3/4	2	2
D1036U	36	42 3/4		8 15/16	4	2 3/4	2	2
D1042U	42	48 3/4		8 15/16	4	2 3/4	2	2
D1048U	48	54 3/4		8 15/16	4	2 3/4	2	2
D1054U	54	60 3/4		8 15/16	4	2 3/4	2	2
D1060U	60	66 3/4		8 15/16	4	2 3/4	2	2
D1066U	66	72 3/4	33	8 15/16	4	2 3/4	2	2
D1072U	72	78 3/4	36	8 15/16	4	2 3/4	2	2
D1078U	78	84 3/4	39	8 15/16	4	2 3/4	2	2
D1084U	84	90 3/4	42	8 15/16	4	2 3/4	2	2
D1090U	90	96 3/4	30†	8 15/16	4	2 3/4	2	2
D1096U	96	102 3/4	32†	8 15/16	4	2 3/4	2	2
D10102U	102	108 3/4	34†	8 15/16	4	2 3/4	2	2
D10108U	108	114 3/4	36†	8 15/16	4	2 3/4	2	2
D10114U	114	120 3/4	38†	8 15/16	4	2 3/4	2	2
D10120U	120	126 3/4	40†	8 15/16	4	2 3/4	2	2
D1630U	30	37 1/4		14 5/16	5	2 3/4	2 1/2	2 1/2
D1636U	36	43 1/4		14 5/16	5	2 3/4	2 1/2	2 1/2
D1642U	42	49 1/4		14 5/16	5	2 3/4	2 1/2	2 1/2
D1648U	48	55 1/4		14 5/16	5	2 3/4	2 1/2	2 1/2
D1654U	54	61 1/4		14 5/16	5	2 3/4	2 1/2	2 1/2
D1660U	60	67 1/4		14 5/16	5	2 3/4	2 1/2	2 1/2
D1666U	66	73 1/4	33	14 5/16	5	2 3/4	2 1/2	2 1/2
D1672U	72	79 1/4	36	14 5/16	5	2 3/4	2 1/2	2 1/2
D1678U	78	85 1/4	39	14 5/16	5	2 3/4	2 1/2	2 1/2
D1684U	84	91 1/4	42	14 5/16	5	2 3/4	2 1/2	2 1/2
D1690U	90	97 1/4	45	14 5/16	5	2 3/4	2 1/2	2 1/2
D1696U	96	103 1/4	32†	14 5/16	5	2 3/4	2 1/2	2 1/2
D16102U	102	109 1/4	34†	14 5/16	5	2 3/4	2 1/2	2 1/2
D16108U	108	115 1/4	36†	14 5/16	5	2 3/4	2 1/2	2 1/2
D16114U	114	121 1/4	38†	14 5/16	5	2 3/4	2 1/2	2 1/2
D16120U	120	127 1/4	40†	14 5/16	5	2 3/4	2 1/2	2 1/2
D16132U	132	139 1/4	44†	14 5/16	5	2 3/4	2 1/2	2 1/2
D16144U	144	151 1/4	48†	14 5/16	5	2 3/4	2 1/2	2 1/2
D16156U	156	163 1/4	52†	14 5/16	5	2 3/4	2 1/2	2 1/2
D16168U	168	175 1/4	42‡	14 5/16	5	2 3/4	2 1/2	2 1/2
D16180U	180	187 1/4	45‡	14 5/16	5	2 3/4	2 1/2	2 1/2

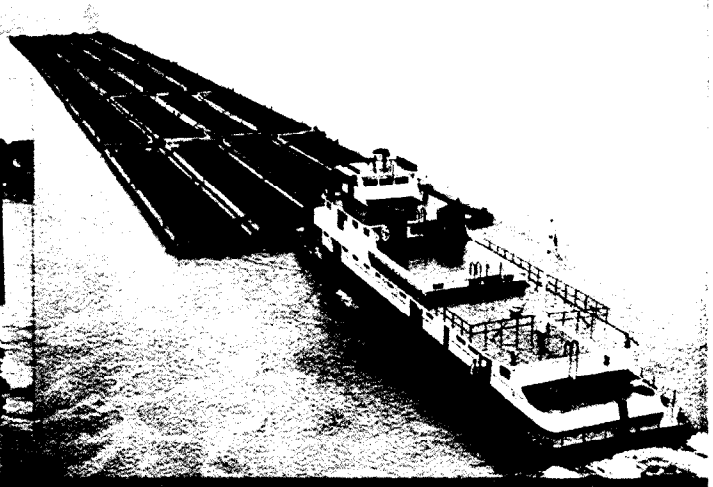
CUSTOM-ENGINEERED FOR ALL TYPES OF VESSELS AND MARINE SERVICE

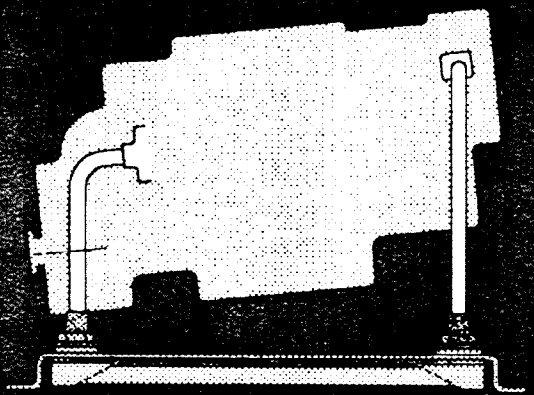




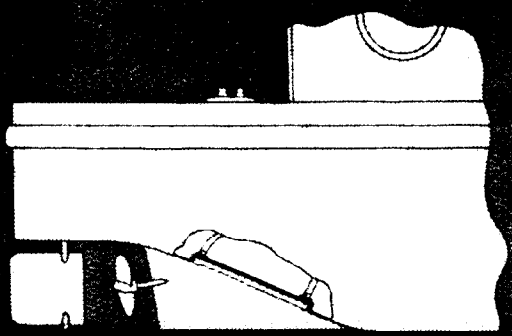




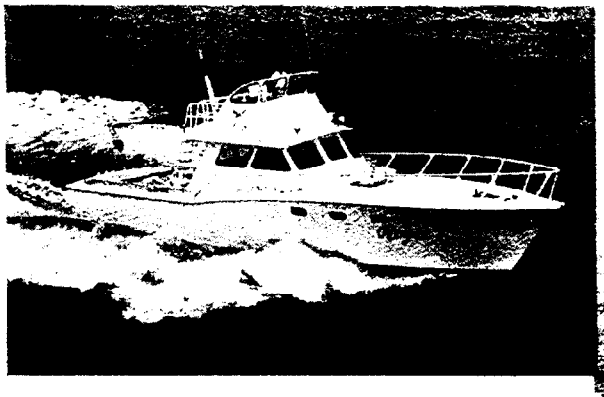


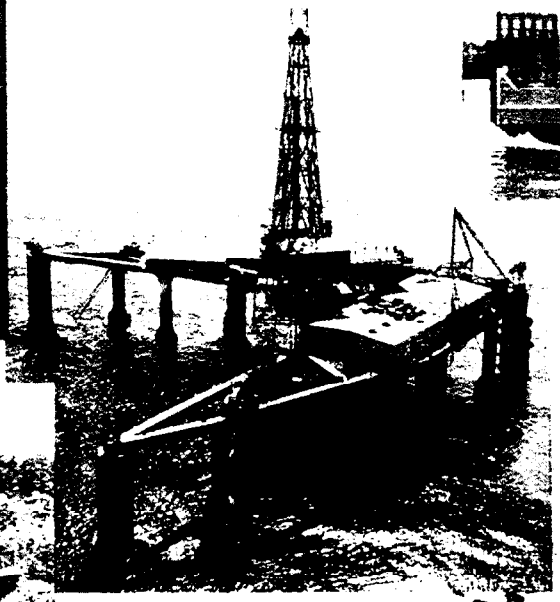


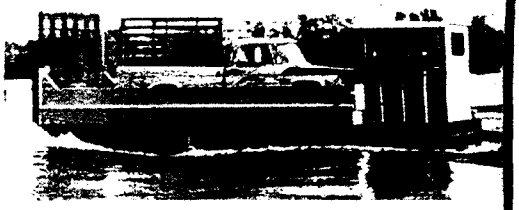
Engine jacket water is piped directly to and from GRIDCOOLER which is in contact with sea water for transfer of heat.

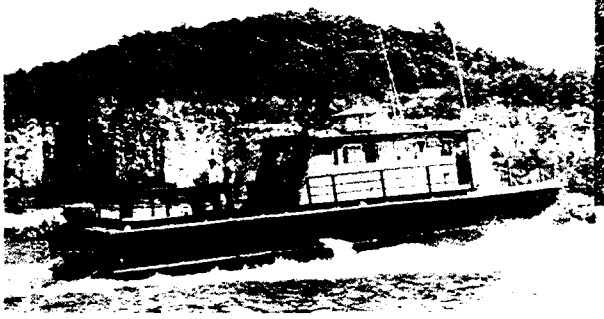


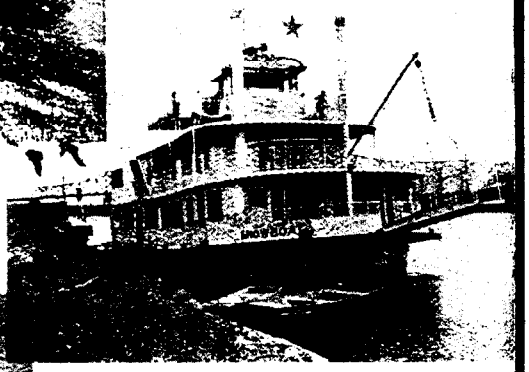
Shallow draft steel river work boat. Flush type installation made by welding in box-shaped recess in underside of hull.

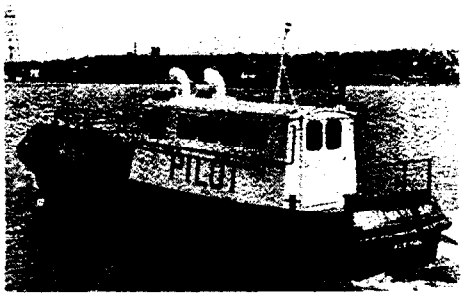








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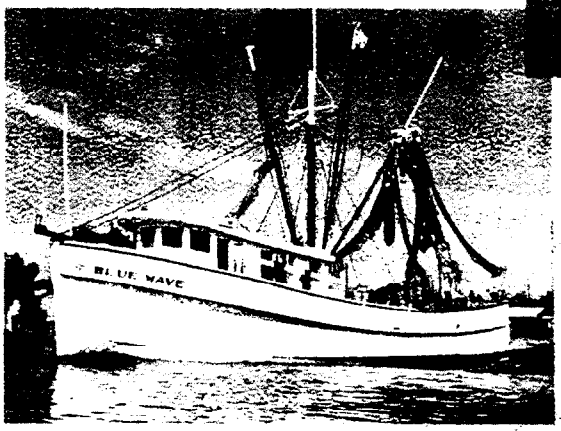
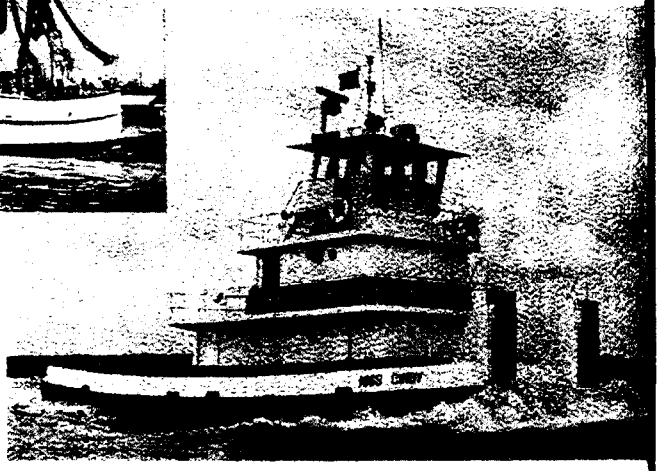

BLUE WAVE



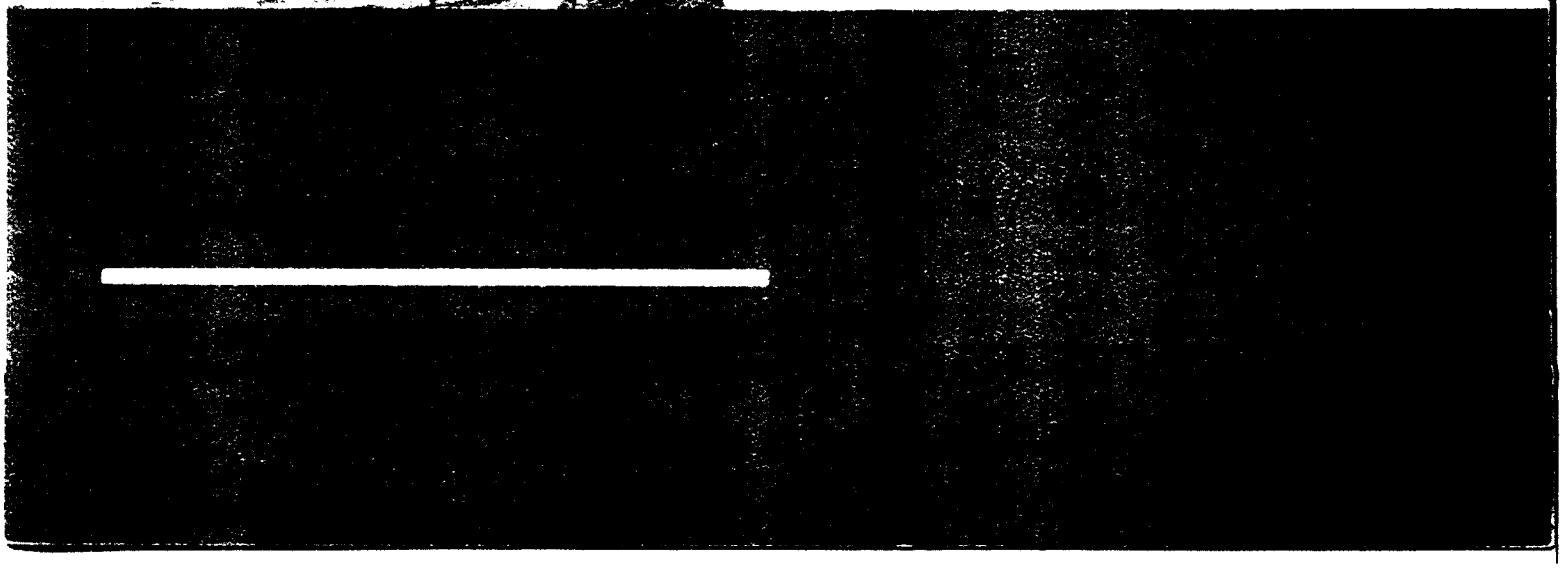
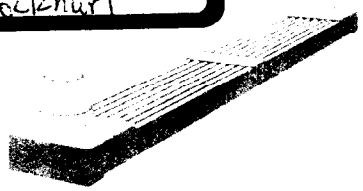
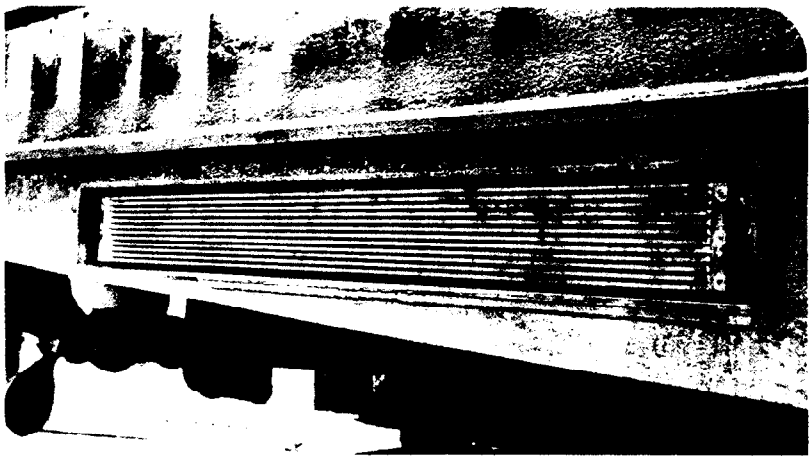


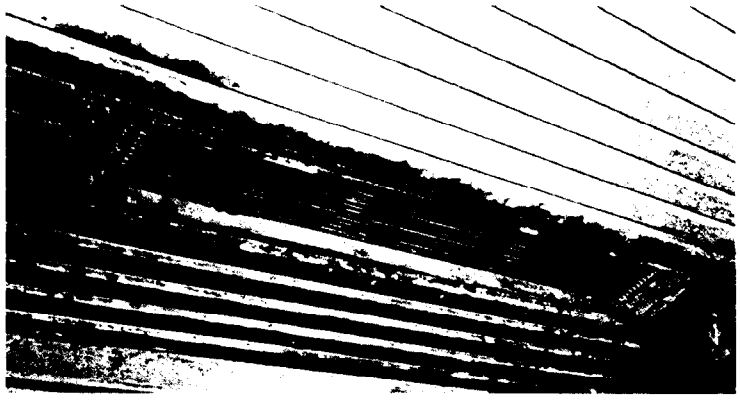
EXHIBIT
Opposer's
Trial Testimony
Dep Ex. 20
Lockhart



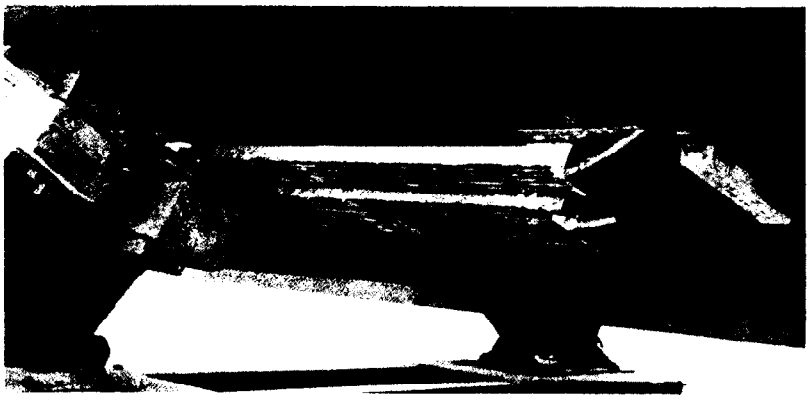
GRIDCOOLER INSTALLATION INSTRUCTIONS



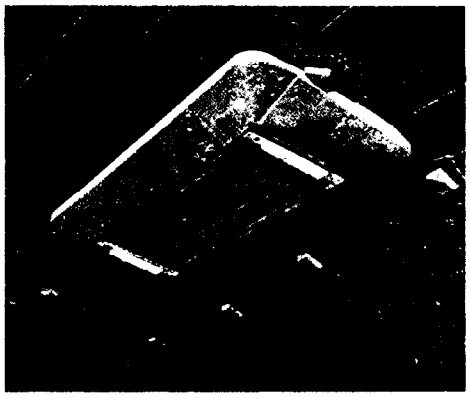
Gridcooler recessed — side mount



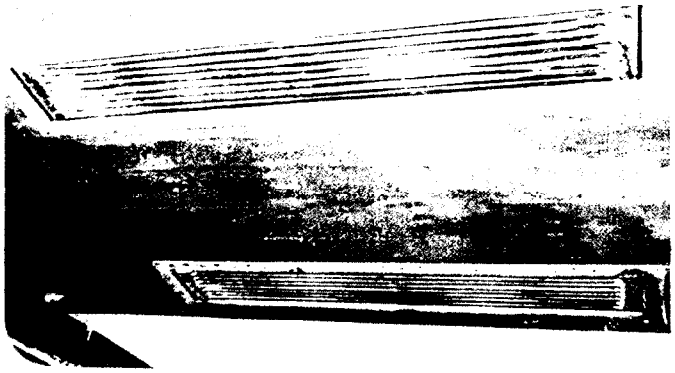
Gridcooler recessed in old channel

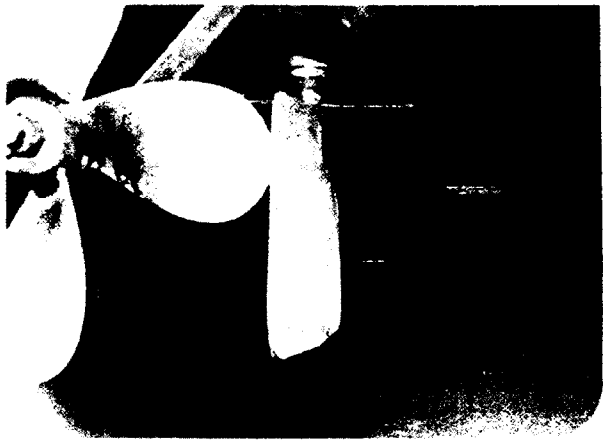


Using fairing blocks — steel hull



Using fairing blocks — wooden hull





Gridcoolers recessed in wooden vessel.
Gridcoolers parallel with keel

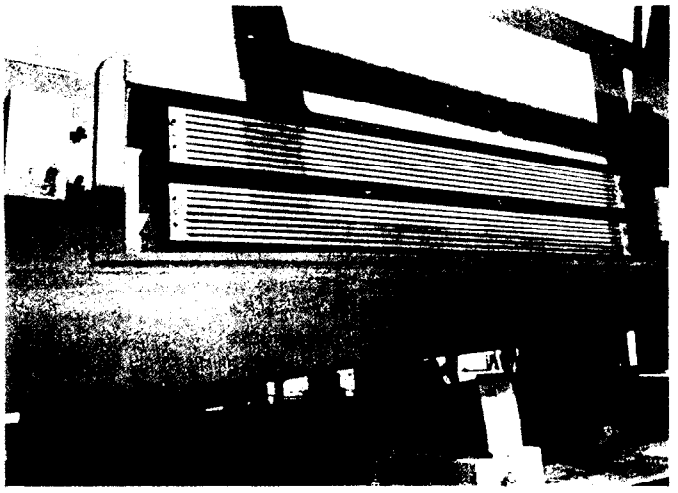
Top left: Fast-moving vessel. Fernstrum Gridcoolers cooling the propulsion engines and generator units.

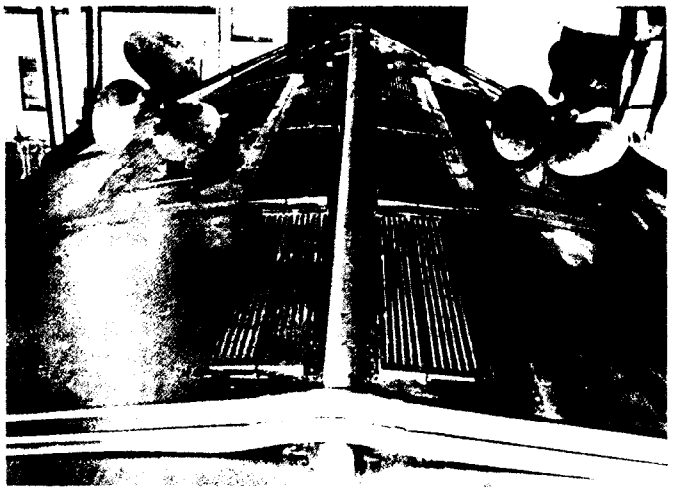
Bottom left: Side recessed mounted Gridcooler also showing placement of zinc electrodes by shipyard.

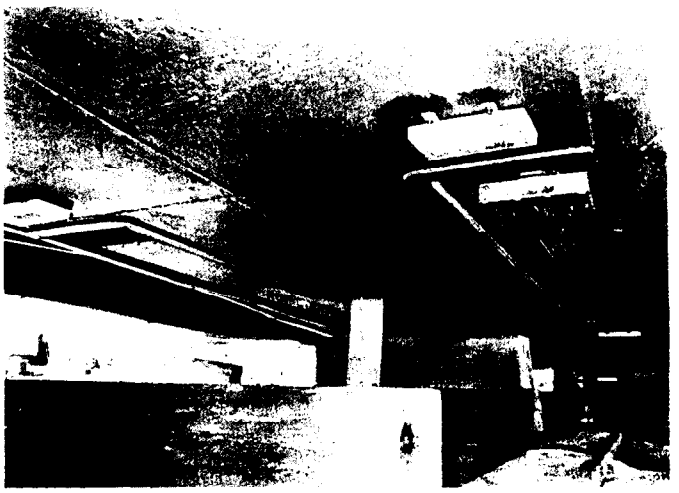
Top right: Side recessed mounted Gridcoolers also showing placement of zinc electrodes by shipyard.

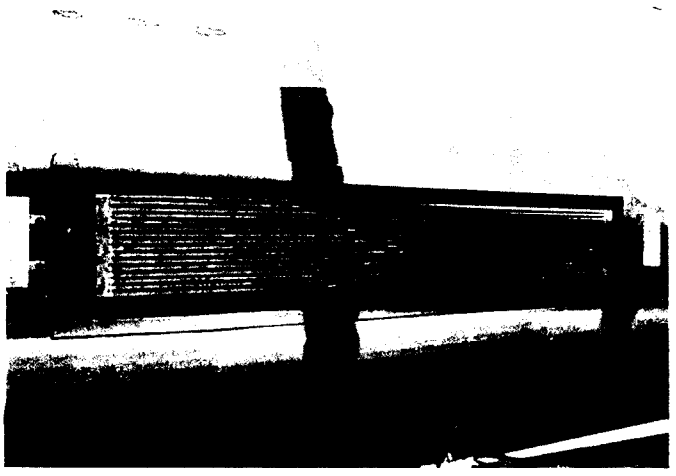
Center right: Recessed Gridcoolers on slight incline on bottom of vessel.

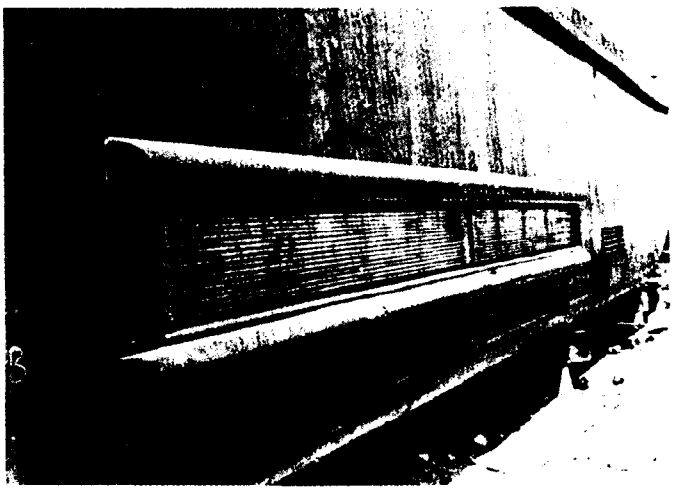
Bottom right: Side mounted Gridcooler with rub rails.











GRIDCOOLERS are constructed of the finest and most suitable materials obtainable. They are assembled, thoroughly tested and inspected by skilled craftsmen. Properly installed, the GRIDCOOLER will give you the utmost in performance and satisfaction.

PLEASE NOTE: In addition to our standard 1/4" gaskets, we now offer 3/4" gaskets for all "D" series Gridcooler models. Please state when ordering.

LOCATION: The following general information is recommended.

(A.) In determining a location for installing the Gridcooler, it is essential to choose an area where there is not a severe problem of vibration or hull flexing.

(B.) Install adjacent to skeg or keel if possible for maximum protection. See Figures 1 and 2.

(C.) Towboat installation should be made as near the propeller as possible to benefit from the slip-stream in extreme towing operations. See Figure 3.

(D.) When side installation is made, the Gridcooler should be positioned well below the water line to avoid aerated water to flow past cooler tubes. Aerated water reduces the heat transfer rate and can result in overheating.

(E.) GENERATORS and AUXILIARY UNITS that operate at dockside or in still water, the Gridcooler should be so installed as to permit free circulation of water past cooler tubes by convection. Installing Gridcooler on an incline is recommended. For this type of application do not recess Gridcooler horizontally as overheating will result due to lack of circulation of water past cooler tubes.

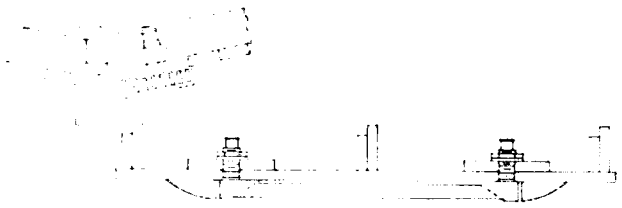
INSTALLATION: Before installing your Gridcooler check the following.

(A.) Check the center to center of Gridcooler nozzles (also center of support studs when applicable) before drilling ship's hull for same.

On steel hull motor vessels, we suggest the through hull hole for the nozzles be 1/4" diameter oversized. Should these holes be burned out, then the hole perimeter must be ground smooth.

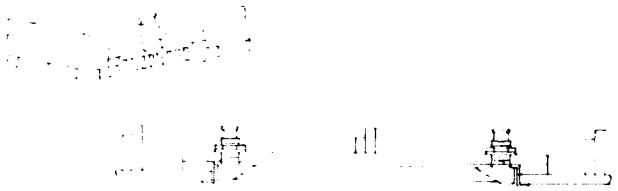
(B.) Make certain that all Gridcooler mounting surfaces on the hull are smooth and in alignment so gaskets will seal properly and prevent any undue stress to the Gridcooler.

(C.) To prevent unnecessary and excessive tightening of supporting nuts for all Gridcoolers in normal installations, we suggest that you use the following torques.



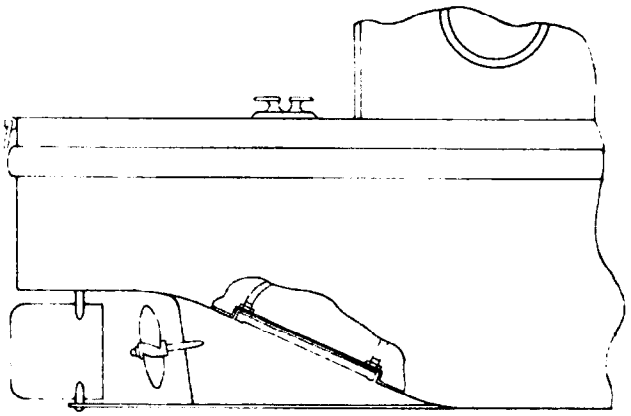
External type installation. Use fairing blocks for protection and streamlining.

FIGURE 1



Flush type installation. In wood hulls flanged housing is recessed for added strength and sealing.

FIGURE 2



Shallow draft steel river work boat. Flush type installation is made by welding in box shaped recess in underside of hull.

FIGURE 3

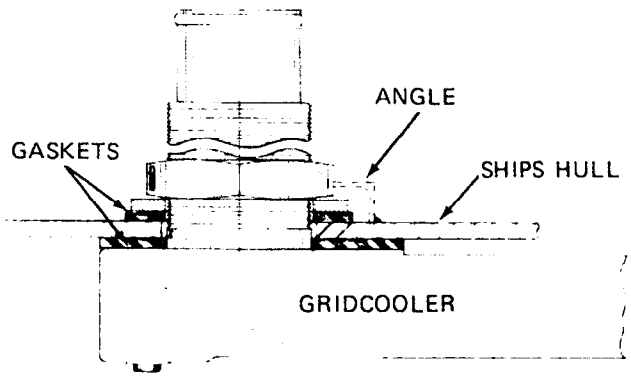


FIGURE 4

Gridcooler Series	Nozzle Nut Foot-Pounds	Support Bolt Nut Foot-Pounds	Header Stud Nut Foot-Pounds
B8U	50 to 60	20 to 25	25 to 30
B	75 to 100	20 to 25	-0-
C8U	75 to 100	25 to 30	35 to 40
C	125 to 150	25 to 30	-0-
D	200 to 250	25 to 30	50 to 60

Tack-weld small angle iron against flat of mounting nuts to prevent loosening of nuts due to vibration. Use GE Marine Seal (silicone rubber) or equal around gaskets, washers, and where nozzles and support bolts penetrate hull for sealing.

(D.) The compression of the mounting gaskets provides a tension to the nozzle nuts (and support bolt nuts when applicable) preventing them from working loose under normal conditions. If a more positive method is desired to secure nuts (especially hulls subject to vibration) a clip angle can be secured to hull with the other face in contact with flat of hexagon nut. See Figure 4.

(E.) When installing a U-flow (two-pass type) Gridcooler in an inclined position, make sure nozzles are at the high end. Piping between engine and Gridcooler should be self-draining to avoid air pockets which would restrict jacket water flow rate and cause overheating.

(F.) See Figure 7. When piping, do not use smaller size tubing or fittings than connections on engine or Gridcooler, as this will restrict the circulation of jacket water. Piping can be of tubing, using hose and clamps at engine and Gridcooler connections to eliminate engine vibrations to hull. Arrange piping for minimum use of elbows. After installation is made, check connections for leaks. When water testing the Gridcooler, do not exceed 35 PSI.

(G.) When using a reducing bell-housing (coffer-dam type construction) in piping to and from the Gridcooler, a good grade of sealer such as GE Marine Seal should be used around the gaskets, washers, and nuts to prevent fresh water from seeping down the threads.

(H.) Gridcooler piping diagrams for multiple Gridcooler installations.

Gridcoolers connected in parallel FIGURE 5

Gridcoolers connected in series FIGURE 6

OVERHEATING: Should overheating occur, use this check list to try and find the problem.

(A.) Check water level in expansion tank.

(B.) Sticking thermostat.

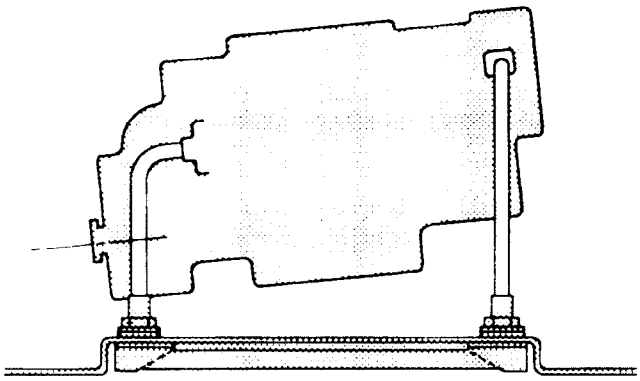
(C.) Check piping for air lock. Add bleeder line if necessary.

(D.) Check circulating pump for wear or adjustment.

(E.) Check to make sure Gridcooler has not been painted or any other coating applied to the cooler. These coatings or paint have an insulating effect and will greatly reduce heat transfer rate.

(F.) Check to make sure there is no aerated water around the Gridcooler. This too will help slow the heat transfer rate.

(G.) If temperature rises when moored to dock, and the Gridcooler has been installed close to the propeller, engage propeller to provide circulation of water past cooler.



Engine jacket water is piped directly to and from GRIDCOOLER which is in contact with sea water for transfer of heat FIGURE 7

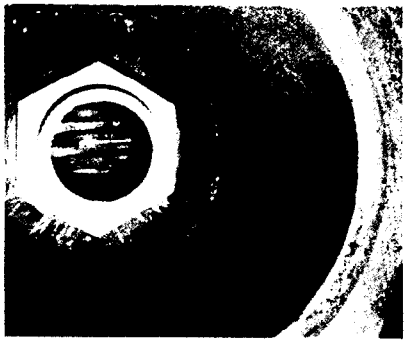
ZINC ELECTRODE PLATES are standard equipment with sea (salt) water type Gridcoolers. Their purpose is to minimize the effects of galvanic corrosion, and should be replaced when deteriorated. Life of zinc plates varies with localities. Rapid deterioration can result from stray electrical currents induced by electrical equipment in craft, which should be corrected.

(Continued on back page)

COFFERDAMS

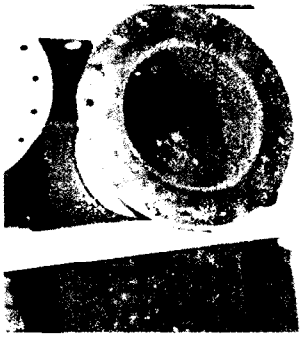
Occasionally, specially designed vessels require cofferdams. These pictures show a commonly used type of cofferdam.

Side mounted cofferdam



Side mounted cofferdam

Cofferdam located inside bottom of vessel



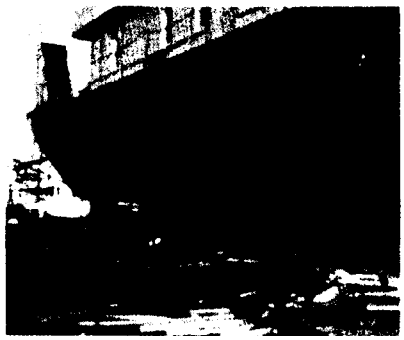
Cofferdams located inside bottom of vessel

PROTECTIVE GUARDS:

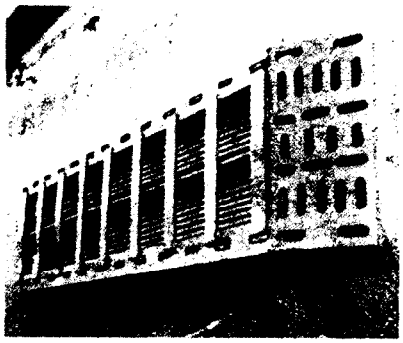
In extreme cases where logs, debris or dragging the bottom of the boat may endanger the bottom of the vessel, a protective guard may be employed over a Gridcooler recess. The following photographs show different types of protective guards.

Guard on one side

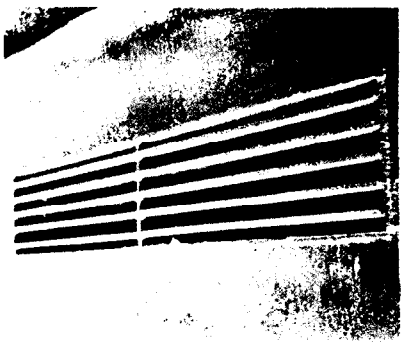
Protective guard made of bar stock



Recessed with rub rails to protect Gridcooler



Bar and sheet stock protects external Gridcooler



Side mounted

DAMAGED GRIDCOOLER: In the event of accidental damage in use, it is recommended that the following materials and steps be taken to make minor shipyard repairs.

(A.) **BRAZING:** Drain Gridcooler before brazing. Make certain that the joint or area to be brazed is thoroughly cleaned, using a good degreasing solvent followed by wire brushing. The silver alloy used in the manufacture of Gridcoolers is "Handy & Harman", 3/32" diameter Easy Flow No. 4 wire, having a melting point of 1160 degrees F. Use "Handy & Harman" Flux, low temperature brazing type. Source of brazing wire and flux is HANDY & HARMAN, 850 Third Avenue, New York, New York 10022 U.S.A. who have many distributor outlets.

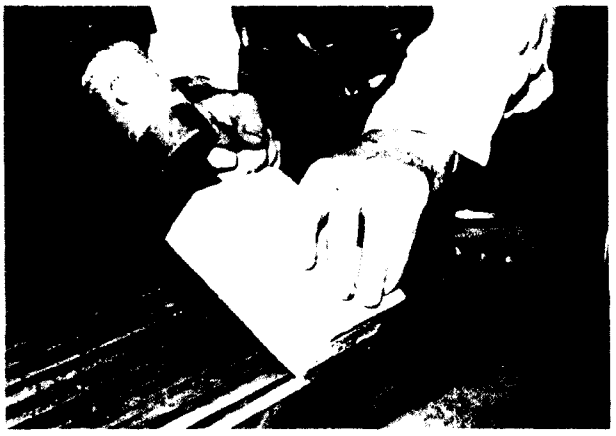
(B.) In the event the tubes are accidentally bent and out of alignment, they can be straightened by using a hard wood block and mallet. Gridcoolers are constructed of ductile materials not subject to fracture.

TEMPORARY REPAIR: For temporary repairs, an epoxy compound similar to Devcon UW for above and under water repairs or Red Hand for above water repairs may be used when liberally applied

Before applying the epoxy compound, the surface must be clean and any internal pressure on the Gridcooler must be removed.

Devcon UW is available from the Devon Corporation, Danvers, Massachusetts 01923. Red Hand is available from International Paint Company, New York, New York.

A



B

WARRANTY: The R.W. Fernstrum & Company, manufacturer, carefully tests and inspects each Gridcooler before it leaves the point of manufacture. The manufacturer makes no representations or warranties, express or implied, statutory or otherwise, except those herein expressly contained and shall not be held liable on any account except for repair or replacement under the terms following.

The manufacturer will, as to each Gridcooler registered with it by the purchaser, repair or replace free of charge, such Gridcooler as is found upon inspection to be defective because of material or workmanship providing the same has been returned to the manufacturer's factory, or a more convenient point as designated by the manufacturer, transportation prepaid, within ninety (90) days from date of installation for use. The manufacturer's obligation hereunder shall be limited to such time period and to the direct cost of repair and replacement and shall not include labor, transportation or other such expenses incurred by purchaser.

This warranty shall not be effective with respect to Gridcoolers to which repairs or alterations have been made unless authorized by the manufacturer, nor to defects arising because of improper installation, misuse, accident, or other causes beyond the control of the manufacturer.

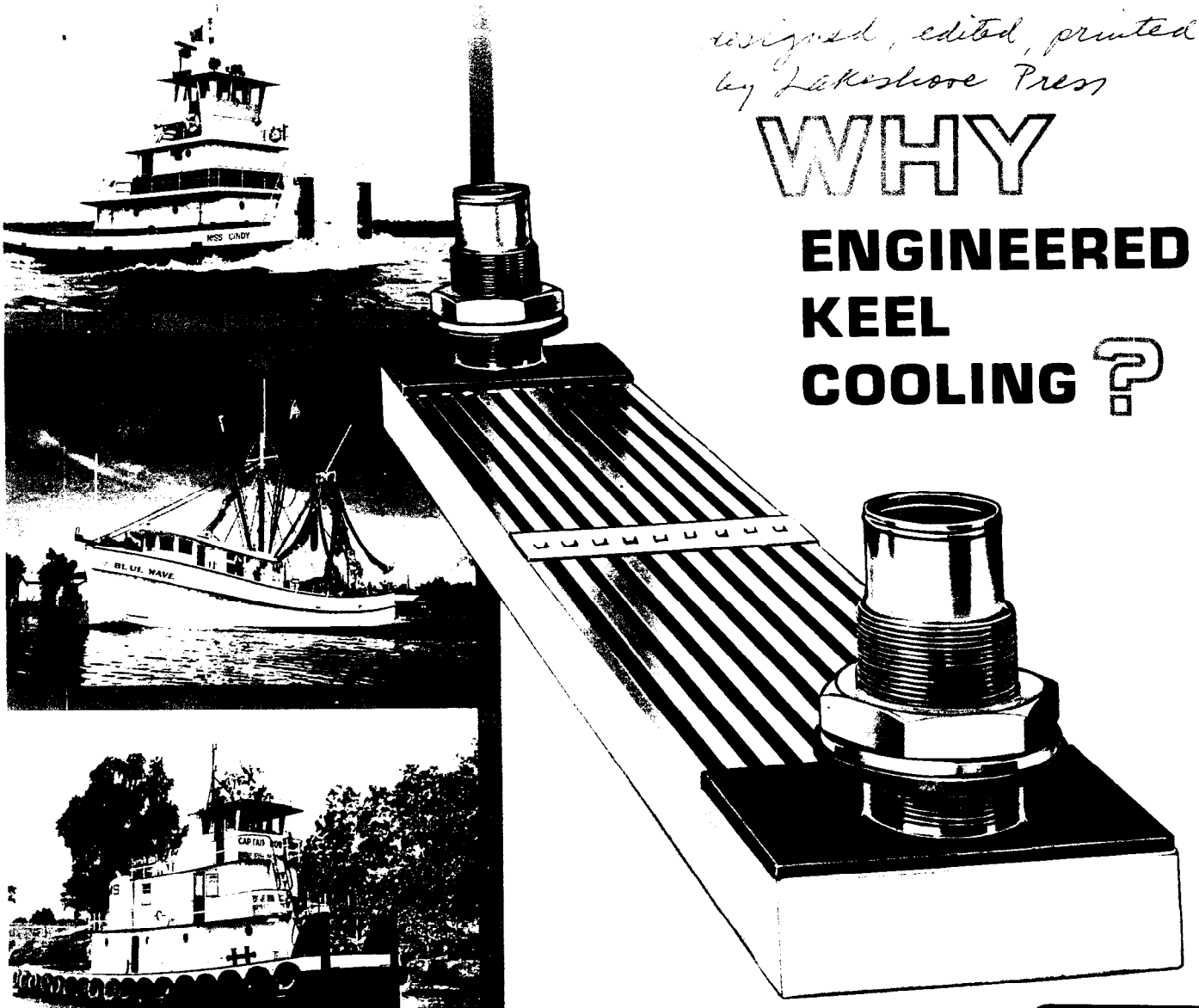
R. W. FERNSTRUM & COMPANY

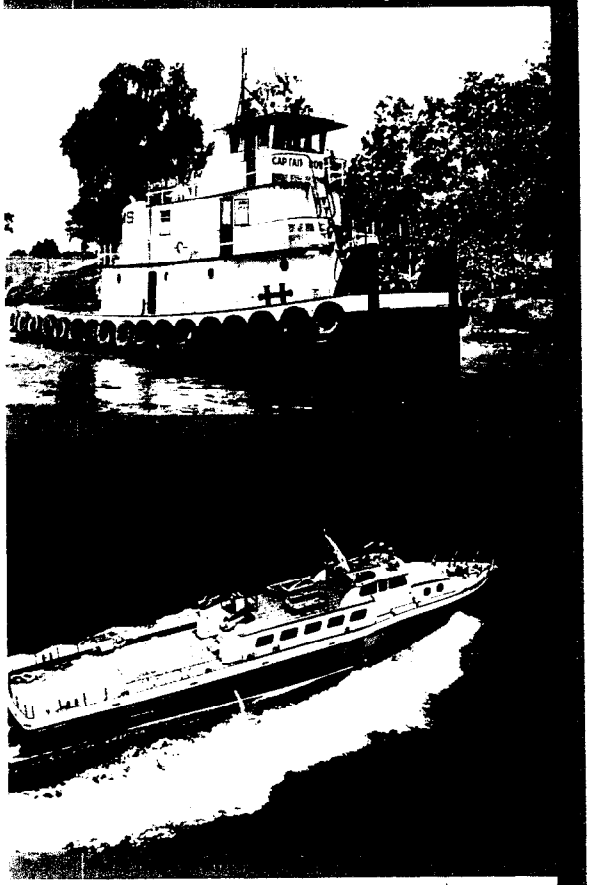
MENOMINEE, MICHIGAN U.S.A. 49858

designed, edited, printed
by Lakeshore Press

WHY

ENGINEERED KEEL COOLING ?





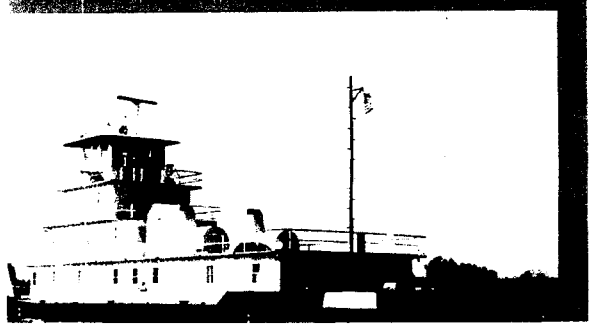


EXHIBIT
TRADES
appears in trial testimony
Depo Ex. 21
Lockhart

YOU GET

CUSTOM DESIGN
COMPLETE ASSEMBLY
FACTORY TESTING
MAXIMUM PERFORMANCE

HERE'S THE FERNSTRUM STORY

WITH A FERNSTRUM GRIDCOOLER® . . .

Add years to the life of your marine engine when you cool it with the Fernstrum Gridcooler!

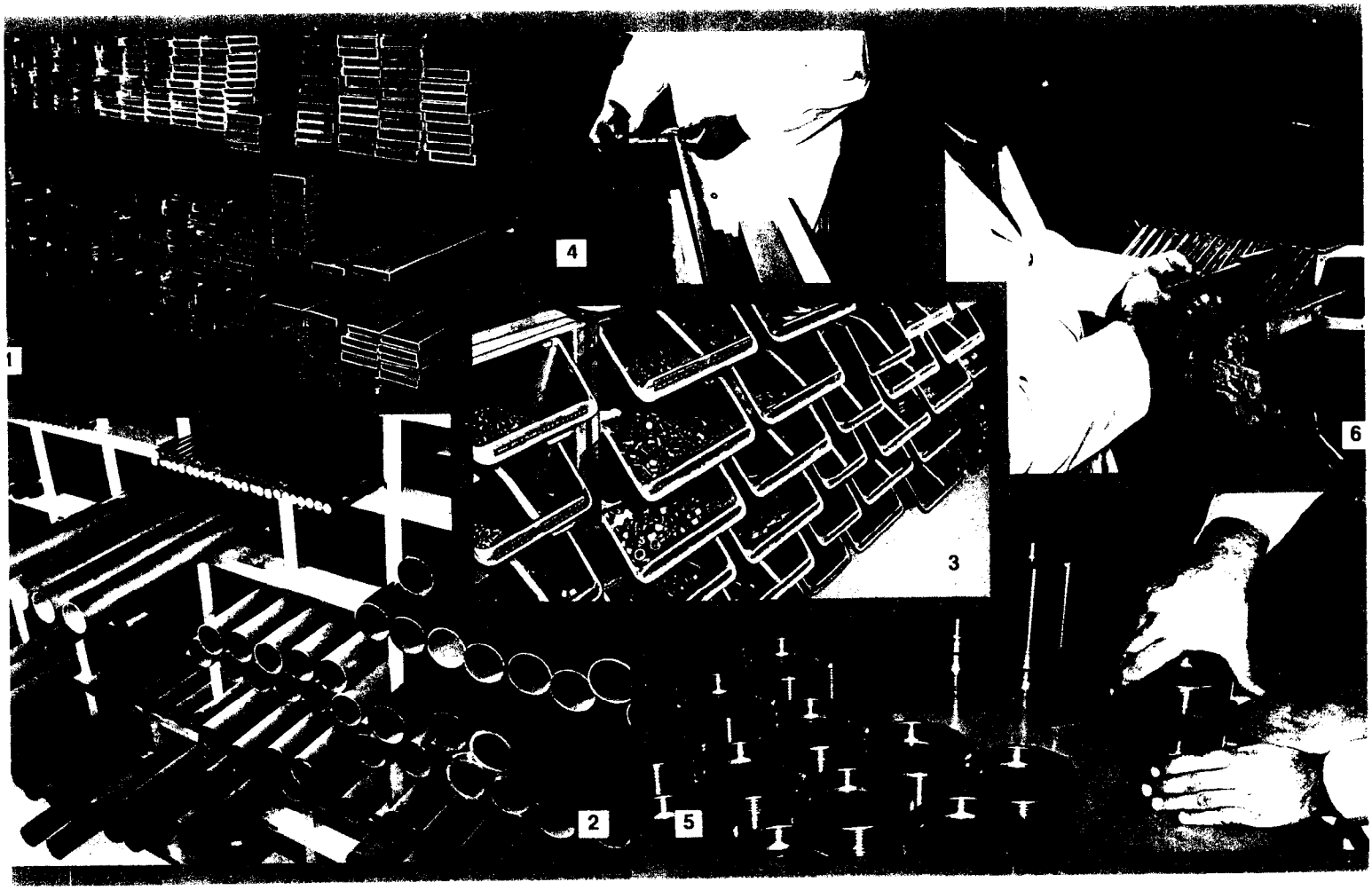
Tailored to your exact specifications, the Gridcooler is designed as a complete assembly . . . the only such unit on the market. There's nothing to add . . . nothing to assemble. Simply attach the Gridcooler to any ship's hull on site.

There's real quality control in manufacturing, too. Three-day's production time goes into the assembly of every unit once the parts have been selected. About 23% of this time is spent in inspection and testing to assure dependability of performance. That's why, with proper installation and normal use, Gridcoolers have been in service for as long as 30 years.

The Fernstrum Gridcooler is upgraded regularly in keeping with the newest improvements in materials and the latest methods of manufacture.

Your ship deserves the very best method of keel cooling and the very best is FERNSTRUM.

LOOK AT FERNSTRUM'S QUALITY MANUFACTURING AND TESTING METHODS:



1•2. Only the finest quality materials are used in manufacturing the Fernstrum Gridcooler.

3. Finished parts are in stock at all times for quick delivery when needed.

4•5•6. Quality control begins as soon as the material is received. All material is 100% inspected. No random sampling methods are used.

7. Each tube is hand-cut to insure quality.

8. To obtain a proper bond, each piece is degreased before assembly.

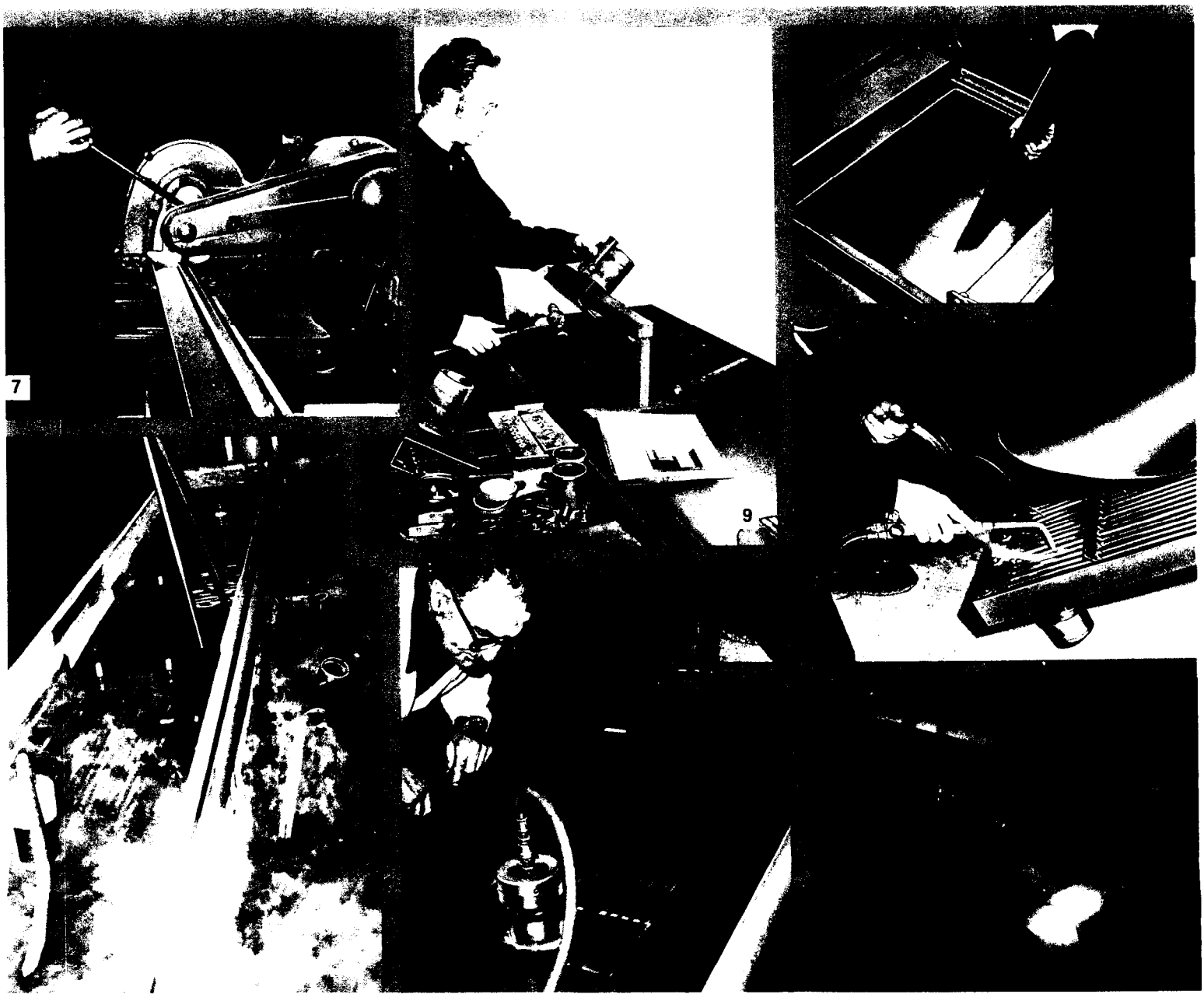
9. For customer protection, each Grid-cooler is assigned its own serial number.

10. Experienced craftsmen, at work in the final brazing stage, use only the finest silver alloys. Less expensive materials do not meet Fernstrum's high quality standards.

11. Each unit is soaked and flushed out at high temperatures during two different intervals of manufacture. This eliminates the possibility of pin hole leaks.

12. Each unit is inspected by running it through two separate underwater air tests.

13. Clean-up by sandblasting is done in a specially constructed 40' long, semi-automatic blasting cabinet.



14. The recent development of ultra-sonic testing, which works on a sonar principal, assures every customer of a Gridcooler of superior strength.

15. In all respects, the unit must be square and true. On successful completion of all quality control checks, each unit receives its own O.K. tag . . . a mark of quality.

16. The O.K. tag is removed and filed with the O.Ked inspection report prior to boxing for shipment. Each unit is fitted with gaskets, washers and nuts for sealing inside and outside of the hull.

17. Each unit is carefully boxed in "Tri-Wall," a triple corrugated, weather-resistant fiberboard. Special wood crating is available for long-term storage.

18. Each Gridcooler is shipped with complete installation instructions. Zinc electrodes, nailed to the cleat in the box, are furnished as standard equipment on all units operating in sea water to minimize galvanic corrosion.

19. The Fernstrum Company is ready to work with you at any time to achieve your exact keel-cooling requirements. Let us ship you the Fernstrum Gridcooler® . . . the best product of this type on the market today.

GRIDCOOLER® THE MOST EFFICIENT ECONOMICAL FORM OF KEEL COOLING

FROM

R. W. FERNSTRUM & COMPANY

1716 ELEVENTH AVENUE • MENOMINEE, MICHIGAN U.S.A. 49858

PHONE: 906 / 863-5553

WHY BUY FERNSTRUM GRIDCOOLERS®

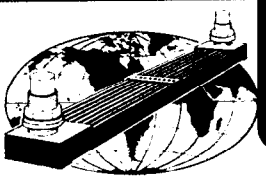


EXHIBIT
Opp. Ex's
Trial Testimony
Depo. Ex. 22
Lockhart

FERNSTRUM
ENGINEERED KEEL COOLING

Some manufacturers make statements about the superiority of their cooling systems as compared to the Fernstrum GRIDCOOLER. In this section, we would like to caution you about some of the misleading statements that may be made by our competitors.

FICTION: A GRIDCOOLER can't be used in high speed applications.

FACT: GRIDCOOLERS are currently being used on high speed crew and patrol craft. The GRIDCOOLER creates a negligible amount of drag in high speed applications, and their sturdy design will hold up under the most demanding conditions.

FICTION: A GRIDCOOLER must be mounted in a recess.

FACT: Any GRIDCOOLER may be mounted in a recess or just externally mounted on the side, bottom or rake of the hull, depending on the vessel design.

FICTION: GRIDCOOLERS require too many through hull fittings.

FACT: Any GRIDCOOLER can use our L-Series option which requires only two through hull fittings, one for the inlet nozzle and one for the outlet nozzle.

FICTION: The GRIDCOOLER is more difficult to plumb than our competitors' coolers.

FACT: The two-pass or U-Flow GRIDCOOLER has both inlet and outlet nozzles on the same end of the unit. The nozzles can use a variety of fasteners including hose connectors, flanges, or threaded pipe.

FICTION: Grooved round tubing is more efficient than smooth rectangular tubing.

FACT: This statement might be true, depending on the cross-sectional area and perimeter of the two tubes used in the comparison, but don't be misled into believing that the grooved tubing used by our competitors is more efficient than our tubing. Efficiency of the cooling units in question can be determined by simply comparing the

QUALITY — Our 100% parts inspection process and rigorous testing procedures insure that all raw material and every GRIDCOOLER is built with the same exacting standards that prompted the U.S. Navy to set their keel cooling standards by the Fernstrum GRIDCOOLER. Nearly 25% of the production time for every GRIDCOOLER is spent in inspection and testing, from raw material to finished product. This level of quality control insures the dependability and performance that has kept our GRIDCOOLERS in service for as long as 30 years.

MATERIALS — A standard series GRIDCOOLER is made of either heavy gauge 90/10 copper-nickel or 5000 series marine grade aluminum rectangular tubing. These alloys were chosen because of their resistance to salt water corrosion and their heat transfer abilities. The copper/nickel units are silver brazed, and the aluminum units are welded. These construction materials and methods provide a level of durability far above any kit cooler.

DURABILITY — While 70/30 copper/nickel is marginally more corrosion resistant than 90/10, its lower heat rejection abilities make it a relatively poor heat conductor when compared to 90/10. However don't be fooled into believing a kit cooler is more corrosion resistant than a GRIDCOOLER. A kit cooler uses a very thin walled tube while our GRIDCOOLER uses a much thicker wall tube. This thicker wall tube and our welded and brazed joints, led the U.S. Navy to give the Fernstrum GRIDCOOLER a 20 year rating.

CONSTRUCTION — Kit coolers use "O" rings and gaskets to hold their coolers together for a "tight" seal. Unlike a kit cooler, the welded and brazed construction of a GRIDCOOLER provides a solid cooler. Welded and brazed joint construction also eliminates the excess wear between vibrating tubes and fasteners that occurs with kit coolers. Sure, you can replace kit tubes a bit easier, but why should you have to replace tubes?

PRECISION — Every GRIDCOOLER is built out of high quality pipe and sheet stock, not cheap out-of-round and thread bare castings or plug and-pray seals. This allows us to let you decide how your GRIDCOOLER will attach to your vessel; and have peace of mind in knowing it will attach properly.

SIZE — The GRIDCOOLER is the most efficient keel cooler available. Our 90/10 copper/nickel has 1/3 more heat rejection ability than the 70/30 copper/nickel used by the competition. Our rectangular tube is much more efficient than the thin spiral round tube used by the competition. The size of our cooler can be easily compared to any of theirs. Based on the same information, our GRIDCOOLER can be as little as half the size of their bulky kit coolers.

PRESSURE DROP — Overheating, uneven engine cooling and air pockets in the cooling system are just a few of the problems associated with excessive pressure drop in an engine cooling system. Any one of these problems will cause premature engine wear and engine failure if the problem is not addressed. It also limits the types of pumps that can be used for coolant flow. Unlike the kit coolers you may see, our GRIDCOOLER is designed to create a minimum amount of pressure drop. Kit coolers using spiral tube create turbulence and turbulence is pressure drop. Kit coolers with only one through hull fitting severely restrict water flow, which creates pressure drop.

size of one unit to the size of the other. If a GRIDCOOLER and a grooved tube cooler are sized for the same application, our GRIDCOOLER will be the smaller unit.

FICTION: 70/30 copper/nickel is more durable than 90/10 copper/nickel.

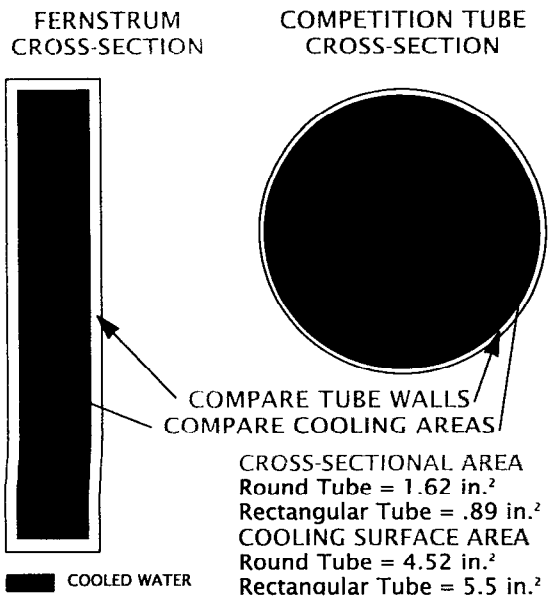
FACT: If you are comparing apples to apples, 70/30 is only slightly more durable than 90/10 copper/nickel. However, in comparing our 90/10 to our competitors' 70/30, you may be comparing apples and oranges. Our 90/10 tubing is twice as thick as our competitors' 70/30. This increase in wall thickness more than makes up for any differences in material.

FICTION: Welded and brazed joints can crack and leak.

FACT: Unlike "O" ring slip joints which leak under vibration, welded and brazed joints will not crack and leak under normal operation, and many units damaged by severe groundings or being struck by debris will still operate effectively without leaks. In a heavy pounding sea, kit coolers and their gasket joints can easily fail. GRIDCOOLERS are built to withstand heavy seas.

FICTION: Brazed coolers can't be bent to conform to a hull's curvature.

FACT: Because of the ductile qualities of 90/10 copper/nickel and the inherent strength of brazed and welded joints, a GRIDCOOLER can be bent to meet your desired specifications.



DESIGN FLEXIBILITY — With over 8000 GRIDCOOLER models available, we can recommend a cooling system that meets the unique needs of your engine on your vessel in your operating environment. Our standard GRIDCOOLER models can use any one of our five tube types, they can have between 4 and 24 tubes and they can be between 21 and 187 inches long (in six inch increments). If the standard configuration of a GRIDCOOLER creates a problem, we can make modifications as needed.

SAFETY FACTOR — Unlike kit coolers, our units have a 75% heat rejection loading, giving a built in safety factor of 25% for pump and impeller wear, internal and external fouling, repowering, etc.

EASY INSTALLATION — Designed to be externally mounted or flush mounted on the hull, the GRIDCOOLER presents no greater problem than ordinary through-hull fittings. The GRIDCOOLER is a completely assembled unit ready for installation, complete with heavy neoprene gaskets for sealing the inside and outside of the hull. If needed, a GRIDCOOLER can be bent to conform to the hull's curvature.

SUPPORT — With over 50 years experience in the marine engine cooling market, we will engineer a GRIDCOOLER to meet your specific application and needs. We can give you advice on cooler placement, installation and service. Should you require an emergency replacement unit, we can have it shipped to you within three business days or less.

VARIETY — Kit coolers might be available in as many as a couple hundred models... GRIDCOOLERS are available in over 8000 standard models, and a near limitless number of specials can be built for your individual application.

NEGLIGIBLE DRAG — At up to twice the size, kit coolers create more drag than our GRIDCOOLER. After a combination of independent testing by the Vienna Model Test Basin and in-house testing was completed, it was proven that the Fernstrum GRIDCOOLER creates less drag than the difference in drag between spraying and rolling a coat of anti-foulant paint on a hull.

DAMAGE — If a kit cooler is damaged, a catastrophic loss of coolant usually follows due to the loss of tubes. Our GRIDCOOLER does not suffer from this problem. Because we use brazed and welded joints, the cooler may leak, but any coolant loss should be replaceable, allowing the engines to continue operating.

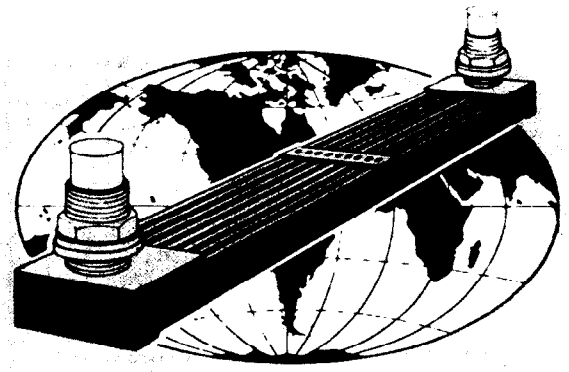
WHY IS FERNSTRUM TUBING BETTER?

In a comparison of our rectangular tube to the competitions' round groved tube, you can see the difference in heat rejection capability.

The blue area of both illustrations shows the area of greatest heat rejection. In this comparison, that area is the distance from the interior tube wall to the center of our tube.

The red area of the round tube represents the area of least heat rejection. While grooved tube creates turbulance to move coolant out of the red area and into the blue, it also moves coolant out of the blue area and into the red.

So what does that do to the size of a cooler? In many circumstances, a kit cooler can be anywhere from 33% to 100% larger than a GRIDCOOLER based on the same cooling requirements. In addition, this sizing difference includes standard cooler loadings of 90% for a



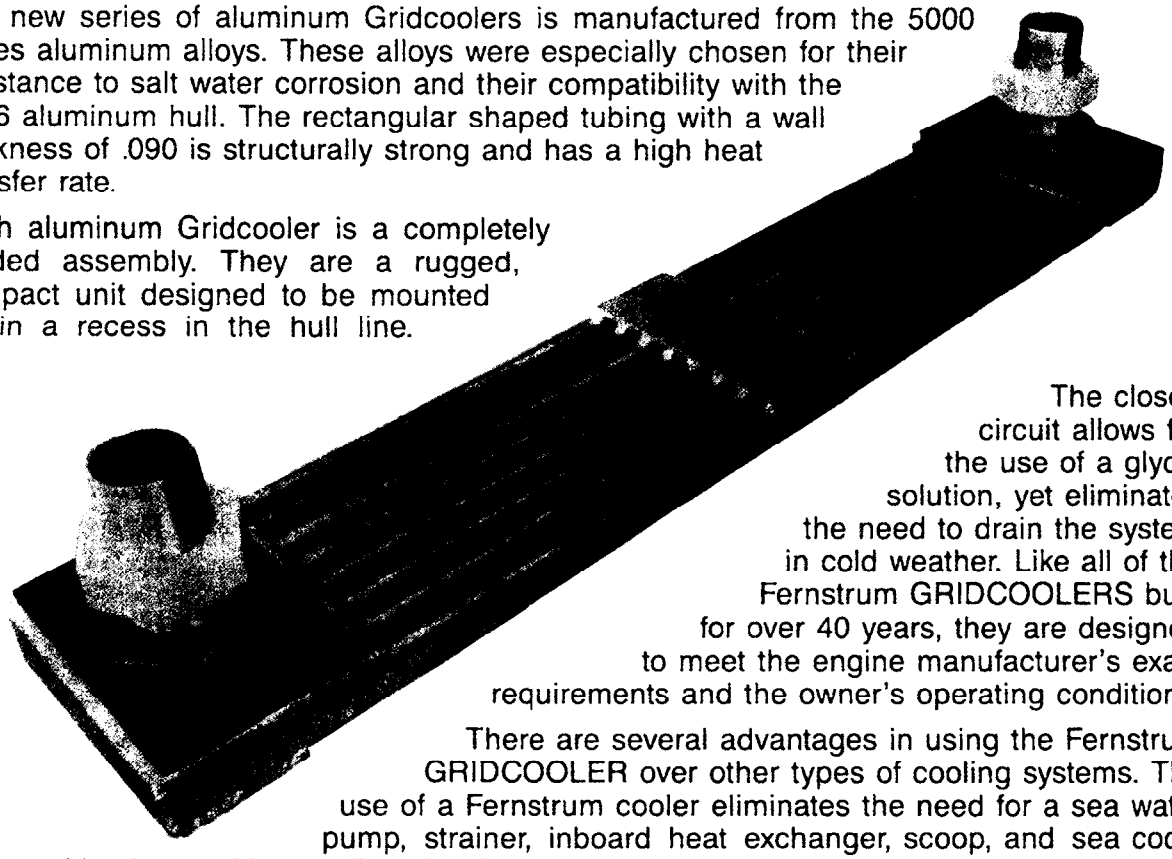
ALUMINUM GRIDCOOLERS are available for cooling marine engines

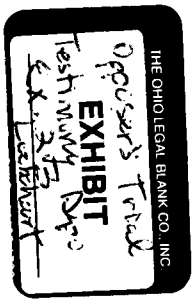
ENGINEERED KEEL COOLING

R.W. Fernstrum & Company has a complete line of aluminum Gridcoolers designed for unpainted aluminum hulled vessels in cold water applications. This line of Gridcoolers will meet the cooling needs of your marine engines, reduction gears, generator sets and air conditioners. Like our standard copper-nickel Gridcooler, the aluminum Gridcooler is a completely assembled unit, factory tested to assure dependability, and not a kit requiring additional assembly before installation.

The new series of aluminum Gridcoolers is manufactured from the 5000 series aluminum alloys. These alloys were especially chosen for their resistance to salt water corrosion and their compatibility with the 5086 aluminum hull. The rectangular shaped tubing with a wall thickness of .090 is structurally strong and has a high heat transfer rate.

Each aluminum Gridcooler is a completely welded assembly. They are a rugged, compact unit designed to be mounted within a recess in the hull line.





The closed circuit allows for the use of a glycol solution, yet eliminates the need to drain the system in cold weather. Like all of the Fernstrum GRIDCOOLERS built for over 40 years, they are designed to meet the engine manufacturer's exact requirements and the owner's operating conditions.

There are several advantages in using the Fernstrum GRIDCOOLER over other types of cooling systems. The use of a Fernstrum cooler eliminates the need for a sea water pump, strainer, inboard heat exchanger, scoop, and sea cock. along with the problems of maintaining a raw water cooling system. Recent tests comparing the Fernstrum GRIDCOOLER system and channel cooling systems have shown savings of 20 to 60% on initial installation costs using Fernstrum coolers. Using Gridcoolers can increase fuel savings by greatly reducing the weight and amount of drag that conventional channel cooling systems have.

All of these factors make the Fernstrum GRIDCOOLER a very cost effective method of marine engine cooling.

R. W. FERNSTRUM & COMPANY, Menominee, Michigan 49858 U.S.A.

Phone: (906) 863-5553 • Telex 26-3493 • Answer Back: FERNSTRUM MNOM • Fax No. 906-863-5634

CHECK THESE UNIQUE QUALITIES ONLY FOUND IN ALUMINUM GRIDCOOLERS:

- Completely assembled and factory tested to assure reliability. No complicated time consuming assembly before installation.
- The most compact form of keel cooling can be easily recessed for a flush with hull installation.
- The only aluminum package keel cooler available, completely compatible with the aluminum hull.
- Heavy gauge 5000 series aluminum rectangular tube, structurally stronger with more cooling surface than round tube.
- Completely welded joints form a rugged keel cooler, no slip joints or "O" rings to leak.
- Custom designed to meet owner's operating conditions and the engine manufacturer's exact cooling requirements.

INFORMATION REQUIRED TO MAKE A RECOMMENDATION

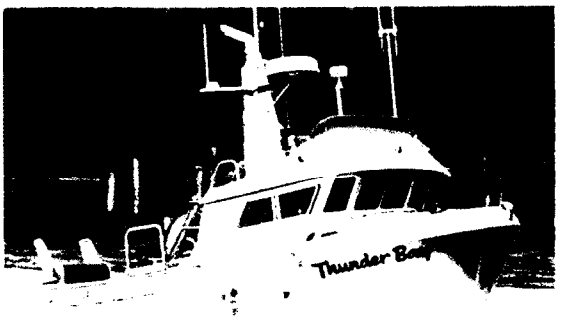
PROPULSION
GENERATOR SET
OTHER

1. MAKE OF ENGINE:

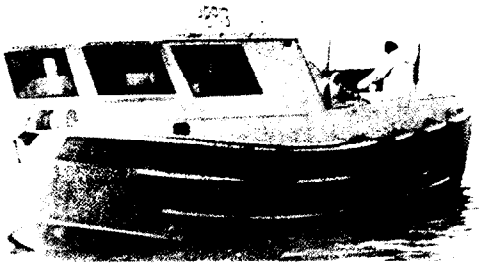
   MODEL OF ENGINE:

   HP/RPM OR KW/RPM RATING:

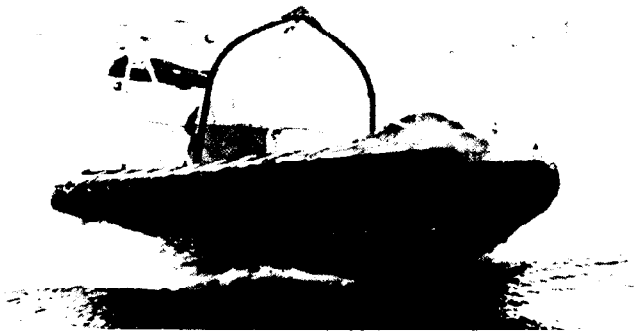
   AGE OF ENGINE:
2. HEAT REJECTION:
3. FRESH WATER FLOW RATE:
4. FRESH WATER TEMPERATURE INTO GRIDCOOLER:
5. FRESH WATER TEMPERATURE FROM GRIDCOOLER:
6. TYPE OF BOAT IN SERVICE:
7. PROPULSION ENGINES
   MINIMUM HULL SPEED @ FULL RATED POWER & LOAD:
8. GENERATOR SET ENGINES
   MINIMUM RAW WATER FLOW RATE OVER GRIDCOOLER TUBES: GPM
9. MAXIMUM SEA WATER TEMPERATURE:
10. HULL MATERIAL: ALUMINUM GLASS WOOD STEEL
11. REMARKS:



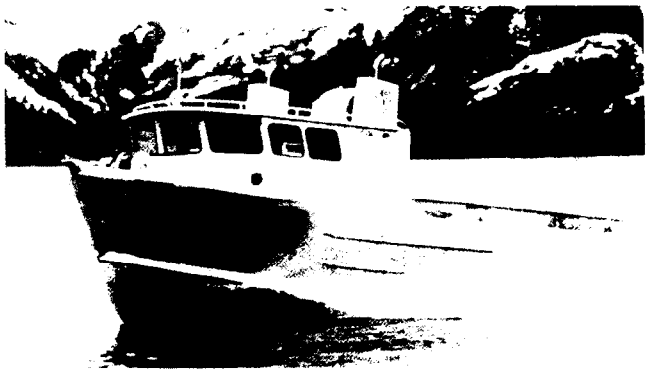
Built by: Rozema Boat Works
Mt. Vernon, WA



Built by: Columbia Boat Building Co.
Astoria, OR

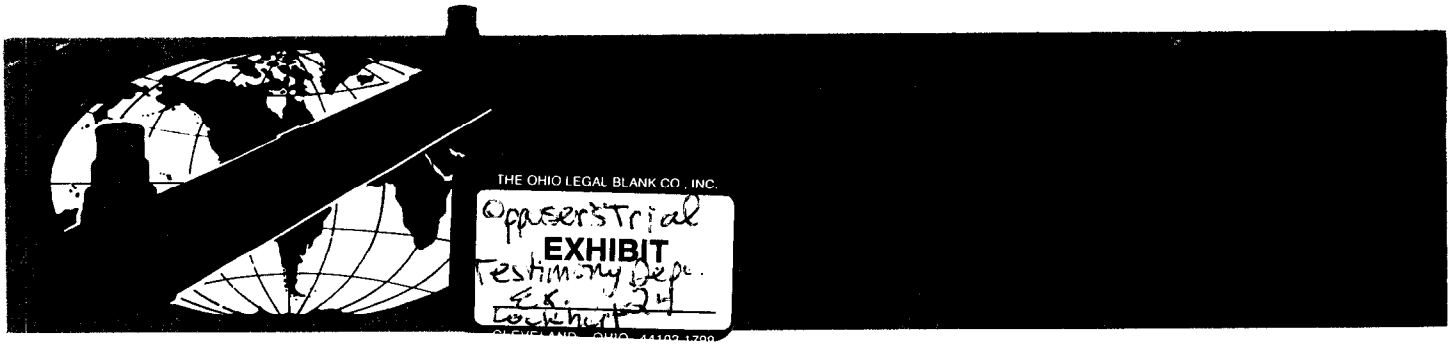


Built by: Crockett McConnell
Bridgewater Nova Scotia, Canada



Built by: Duane Welding & Marine
Anchorage, AK

R. W. FERNSTRUM & COMPANY, Menominee, Michigan 49858 U.S.A.



ENGINEERED KEEL COOLING

A box cooler, like our Gridcoolers, is a cooling unit that operates below the water line. Unlike the Gridcooler, the box cooler is placed in a sea chest instead of outside of the hull in a recess or flush mounted to the hull. This gives the box cooler a greater amount of protection, and allows us greater flexibility in sizing one or multiple units for your specific needs.

For example, instead of changing just the length of tubes, or the number of tubes the cooler uses in width. we can stack the tubes that are used in a box cooler. We currently have Gridcoolers that are two tubes deep, but the box units can be two, ten, fourteen or more tubes deep as well as any number in between.

The drawback to box coolers is space. Because they are placed in a sea chest, space must be set aside within the hull for the sea chest, unlike our Gridcoolers which need only space outside of the hull (unless they are recessed).

Construction

To date, box coolers have normally used steel, brass or bronze construction. The new Fernstrum box cooler construction uses the same materials as our Gridcoolers, 90-10 copper-nickel. The tube used is our "D" series tubing or a small diameter round tube.

Approximate size of the units is the same as that of our Gridcoolers sized for a 1/2 mph flow, except for the fact that the tubes are mounted differently.

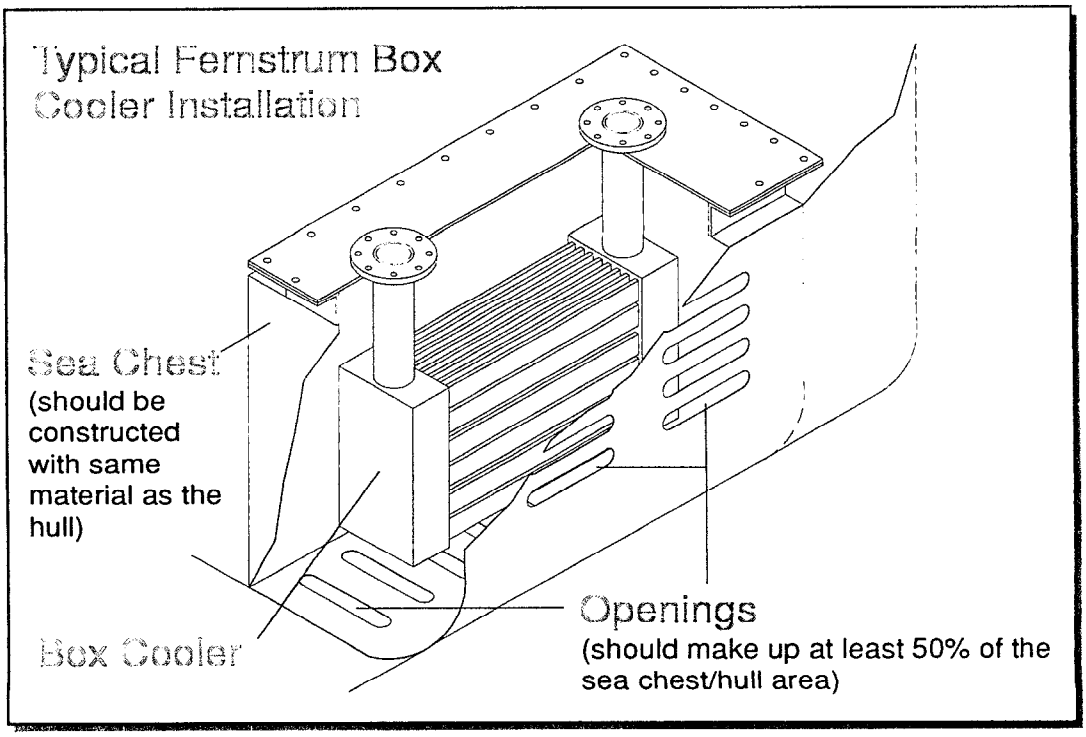
Why Box Coolers?

For years, R. W. Fernstrum & Company has been trying to open markets in Europe for our Gridcoolers. Our attempts have been met with limited success. It seemed that our main problem in gaining acceptance in that market place was the European belief that box coolers were better than our Gridcoolers. True or false, right or wrong, this was our obstacle to overcome.

As the saying goes, "If you can't beat'em, join'em." We decided that if we couldn't sell them our Gridcoolers, we might as well sell them a box cooler; so we set out to design a box cooler that would meet all of the standards we had set for our Gridcoolers.

After months of research and development, we came up with a box cooler good enough to bear our name.

But why use a box cooler in the states? What's the big advantage over Gridcoolers? The box cooler enhances our Gridcooler line by offering better protection against damage from logs and other heavy debris than a recessed Gridcooler. However, the cost of this added protection is a sea chest inside the hull. At this time, we don't recommend using box coolers in areas with heavy pounding seas.



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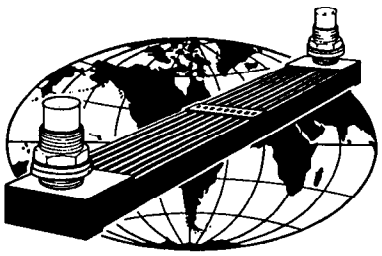
Second of a Series



FERNSTRUM
ENGINEERED KEEL COOLING

Our second test boat was a new 1987 Cruisers model 337 Esprit which we named *GRID II*. This test boat had an overall length of 36 feet and a beam of 11 foot 8 inches with a displacement of 12,500 pounds. This type of vessel was chosen for its greater size and displacement than *GRID I*.

The original propulsion was provided by two 350 Crusader raw water cooled engines producing a total of 700 hp at 4400 rpm.

After an adequate break-in and boat familiarization period, our speed trials began on October 20, 1986 with the original raw water cooling and factory painted hull. The tests were conducted over the same measured mile as GRID I's, and were made at the same four RPM settings (2500, 3000, 3500 and 4000). Every attempt was made to standardize the environments in which the tests were made so that the comparison of test results would be meaningful. We found the craft without Fernstrum GRIDCOOLER keel coolers capable of sustaining 31.61 knots @ 4000 RPM and 13.02 knots @ 2500 RPM.

In the spring of 1987, the raw water cooled engines were converted to a closed fresh water cooling for the engine jacket water system. This was accomplished by adding a GRIDCOOLER keel cooler, expansion tank, and manifold baffles (separators). The raw water pump was retained to cool the exhaust elbow and muffler. Initially we wanted dry exhaust, however, this would have been complicated to install in the existing engine compartment.

Speed trials during 1988 were with GRIDCOOLER keel coolers mounted on the hull with fairing blocks fore and aft of the keel coolers. The keel coolers were mounted directly forward of the propellers. We would have preferred to mount them farther out on the sides of the boat, but the fuel tanks blocked that kind of installation. The keel coolers also could not be recessed on this boat due to the lack of space for a recess in the pre-configured engine room. To recess the keel coolers in the proper location, the recesses would have to be formed when the fiberglass hull was laid up.

The mounting of the keel coolers aided the speed of the boat at lower RPM settings by directing the flow of water towards the propellers. Unfortunately, this location also starved the propellers for water at higher RPM settings. This lowered the speed more than would be expected with Fernstrum GRIDCOOLER keel coolers mounted away from the propellers.

Over the testing period, the following effects to hull speed were noted.

RPM	BARE HULL KNOTS	GRIDCOOLER W/FAIRING BLOCKS KNOTS
2500	11.31	11.74
SPEED INCREASE		0.43
PERCENT INCREASE		3.8%
3000	16.94	16.75
SPEED LOSS		0.19
PERCENT LOSS		1.12%
3500	23.26	22.1
SPEED LOSS		1.16
PERCENT LOSS		4.99%
4000	27.47	26.23
SPEED LOSS		1.24
PERCENT LOSS		4.51%

All speeds listed have been averaged over several runs on a measured mile.

All speeds are in miles per hour.

Since we couldn't recess the keel coolers, and because we wanted an independent appraisal, we also had drag tests run by the Vienna Model Test Basin. The test results we received from them are available upon request.

The next boat we test, *GRID III*, will be a 40+ foot vessel with diesel engines and a dry exhaust system. The design of the vessel will have to be more closely monitored than *GRID II*, due to the incompatibilities encountered when we considered recessing keel coolers.

GRID III will allow us to recess keel coolers and place them closer to the sides of the boat, away from the propellers. It will also allow us to test a boat with a dry exhaust system.

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Fernstrum delivers a cool product Worldwide

By MARK CLEVENGER

R.W. Fernstrum and Company has had an agent in Singapore for better than two years. But according to Dale Gusick, who fills a double role as US plant manager and export sales manager, the company that specializes in keelcoolers plans increased attention to the important Australasia market.

Fernstrum representative in Singapore is Meiwa Marine Industrial, Pte, Ltd, whose managing director is Tay Jin Yah. Meiwa is located at Block 5073, Ang Mo Kio Industrial Park 2, No 04-1644, Singapore 2056. The firm can be reached by telephone at 481-9843 or by Telex through RS2032Meiser.

Keel cooling first appeared in the early 1800's when someone hung a copper tube over the edge of a boat to condense steam, according to the company. This arrangement later evolved into pieces of channel tubing welded into the hull. While these channels eliminated silt and sand in engine jackets and protected engines against salt water corrosion, they increased the ship's drag. They were also prone to seaweed fouling.

The US Navy extensively tested the Fernstrum Gridcooler design after World War II. US Navy specifications were subsequently written around the Gridcooler. The Fernstrum Gridcooler is now used on the majority of vessels operated by the US Navy, Coast Guard, and Army.

Gusick said you will now find Gridcoolers used in fishing boats, dredges, tow boats, seismic vessels, offshore supply vessels, pleasure boats, irrigation pumping stations, generator engines, bow thruster engines, fire pump engines, and compressors aboard vessels.

The firm has also introduced a line of Gridcoolers for use on drill rigs and production platforms. The company developed a rectangular copper tube that will withstand the higher pressures encountered in keel cooling auxiliary engines used in the off-shore industry.

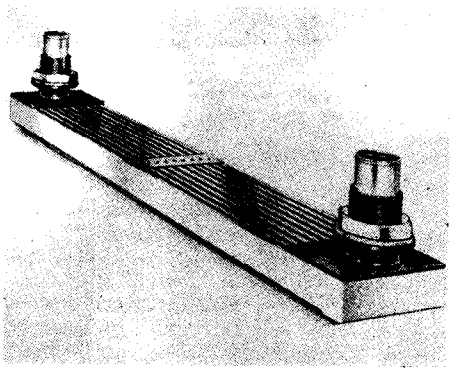
This new line of Gridcoolers (TB32 series) have standard 3½" pipe flange fittings, gaskets, and mounting straps to simplify installation.

Gusick said that the TB32 will save substantial horsepower for oil installations by eliminating the need for cooling fans or seawater pumps.

Fernstrum engineers have designed a variety of unusual installations. For example, the Gridcooler was used to cool a CAT 3406 PCTA bow thruster engine on a 225-ton tuna seiner, "Carolyn M", built by Peterson Builders, Inc, Sturgeon Bay, Wisconsin. The bow thruster was built with a recess in the tunnel to accommodate a Fernstrum Gridcooler.

A keel cooler is an outboard heat exchanger that is either attached to or built as part of the ship's hull. Fresh water is circulated through the cooler by the engine driven fresh water pump.

A compact, modular unit, the Gridcooler can be mounted almost anywhere on the ship's hull. On shallow draft river boats, for instance, the Gridcooler may be mounted on the side of the hull or beside the skeg. On towboats, the Gridcooler may be installed near the propeller to take advantage of its slip-stream during heavy towing. On fast moving vessels, the unit is normally recessed alongside the keel. Two or more Gridcoolers can be installed parallel or in series.



The simple, yet effective, construction of a Fernstrum Keelcooler is exemplified by this typical Gridcooler.

While the Gridcoolers may be installed on the surface of the hull with fairing blocks of streamlining, recessing them flush with the hull affords maximum protection and minimum drag.

Fernstrum Gridcoolers are especially suited for lifeboat applications, Gusick said. The cooler is always ready to operate immediately, so valuable life-saving time is not lost priming the circulating pump.

Fernstrum Gridcoolers excel where traditional raw water cooling systems would be inefficient. A vessel using a Fernstrum keelcooler may be operated in ice laden waters, mud flats, or shallow, silt filled waters.

Many installation and maintenance savings result from elimination of an inboard heat exchanger, seawater pump, strainer, and sea cock, although wet type exhaust systems usually require a small capacity pump.

The Fernstrum Gridcooler is a completely assembled unit that comes with heavy neoprene gaskets. They are available in over 200 standard commercial sizes to meet a wide range of engine requirements and operating conditions. The coolers are built of heavy gauge 90/10 copper nickel alloy or 5000 series aluminium alloy.

Gusick pointed out that you get more than well-built hardware when you buy a Gridcooler. Fernstrum technicians try to find out as much about your installation as they can to deliver the correct equipment.

When sizing a keelcooler, Gusick said, the worst possible operating conditions must be considered. Other factors are minimum hull speed under full power and maximum seawater temperatures. Maximum heat to be rejected, fresh water temperatures, internal fresh water velocity, and whether antifreeze will be used must also be taken into account.

Engine water temperature limits are controlled by the size of the cooler. Heat transfer rates through any cooler, Gusich said, depend mainly on cooling water temperature, cooling water flow, heat transfer surface area, and heat conductivity of the material being used.

In regions of high sea water temperatures, the use of a packaged keel cooler made of corrosion resistant material is almost mandatory.

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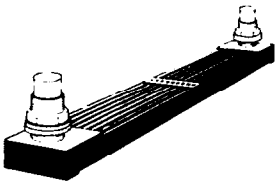

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Pg 52

Attn: Rich Lockhart

Per our discussion, last week.

Hope your trip back was ok

Jack

PRODUCT ROUNDUP

Smaller coolers can take the heat

Enhanced Fernstrum unit features improved heat-exchange capacity.

BY MICHAEL CROWLEY

Like a lot of important but inaccessible parts of a boat, the keel cooler is not something that can be visually inspected by a walk through the engine room. But even if it were, the keel cooler is so simple in appearance, you wouldn't think much about it, and you probably wouldn't think that one is much different from another.

Just to show how wrong that thinking is, R.W. Fernstrum & Co. has just come out with a newly designed keel cooler that contains the first major changes to its line of keel coolers since the 1970s.

After two years of testing, R.W. Fernstrum & Co. has changed the interior surface of their keel coolers' tubing (made with 706 copper, a mixture of 90 percent copper and 10 percent nickel) to provide better cooling.

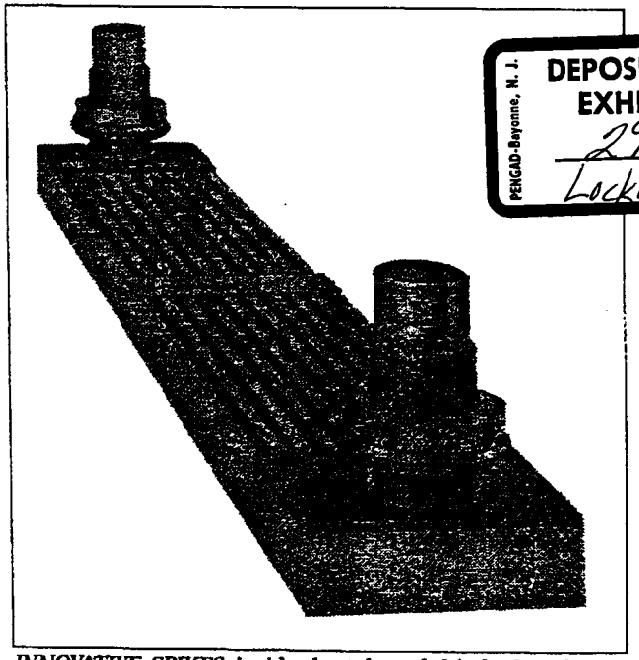
As a result, "The increased heat exchanging capacity is between 17 percent to over 30 percent, though it tends to be between 25 percent and 30 percent," Sean Fernstrum says.

The company's literature says that the tubing's interior surface has been enhanced. What this means is that the surface has been covered with conical-shaped spikes, 1/32 inch or less in height.

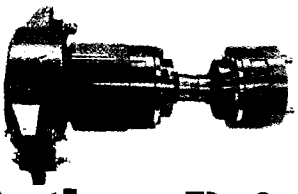
When water passes through the keel cooler's tubes, the spikes create a turbulence in the water flow, which moves water from the center of the tubes out to the cooling surface, as opposed to regular tubes where the water flows straight through.

Thanks to its enhanced keel cooler, Fernstrum says, an operator who repowers with a larger engine may find that he can handle the increased heat load without having to increase the size of the keel cooler from what was previously used. By the same token, operators who are replacing keel pipes will be able to use a more compact installation with Fernstrum's enhanced unit. The efficiency of the new keel cooler depends on the velocity of the coolant running through the pipes and how fast the water flows over the tubes on the outside of the hull. Since fishing vessels spent a lot of time running at idle or slow speeds, the sizing of the keel cooler is important. Fernstrum says that for fishing boats, the company sizes for worst-case scenarios: "We size them for 2-knots," he says.

R.W. Fernstrum & Co has more than 100,000 models of keel coolers from which to choose from. They also build special orders. Contact: R.W. Fernstrum & Co., 1716 11th Ave., P.O. Box 97, Menominee, MI 49858; tel. (906) 863-5553. Circle Reader Inquiry No. 1.



INNOVATIVE SPIKES inside the tubes of this keel cooler create turbulence as water flushes through.



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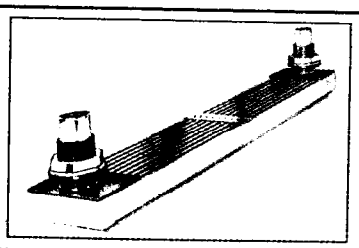

The Fernstrum GRIDCOOLER Keel Cooler is a closed-circuit cooling system engineered to meet your engine's cooling requirements and operating conditions. It is a durable, compact unit that comes completely assembled, made of 90/10 copper-nickel or 5000 series aluminum tubing. R.W. Fernstrum & Company has 50 years experience in cooling marine engines.

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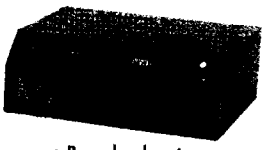

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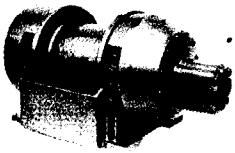

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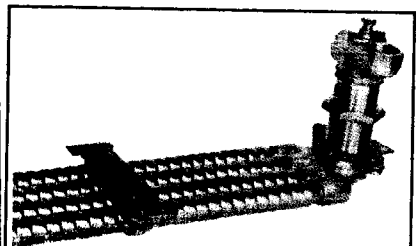

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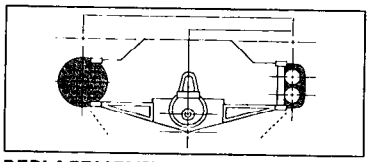

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"Midland is a big, big cow to swallow," Horn said.

Midland will be a relatively smaller portion of KeySpan than it was of Eastern, said Raskin, whose future role with the company has yet to be decided.

Midland, which Eastern acquired in 1961, has a fleet of 2,300 barges and 87 towboats. It hauls mainly coal and other dry bulk cargoes. Midland employs approximately 1,300 people, about 44 percent of Eastern's total work force of 2,900.

For the nine months ended Sept. 30, Eastern's revenues totaled $660 million, with natural gas accounting for $452.4 million and the marine side $196.8 million.

Marine revenue rose $2.1 million from the year before, reflecting an improved export grain market and increased imports of ores and steel-related raw materials. But the increase was offset in part by lower demand from utilities for coal.

— Dale K. DuPont

Northwest shipyard lands Canadian partner

That their booths at the recent WorkBoat Northwest Show in Seattle were side by side was just a coincidence. Given their new relationship, however, the exhibition's juxtaposition of Vancouver Shipyards Co. Ltd. and Bellingham (Wash.) Bay Shipyard symbolized their new financial and working relationship.

Just prior to the show, officials from both companies agreed to an arrangement in which the Washington Marine Group (owners of Vancouver Shipyards, Vancouver Drydock Co., Victoria Shipyards Co. Ltd., Seaspan International, C.H. Cates & Sons Ltd. and many other commercial marine businesses in British Columbia) purchased 49 percent of Bellingham Bay Shipyard.

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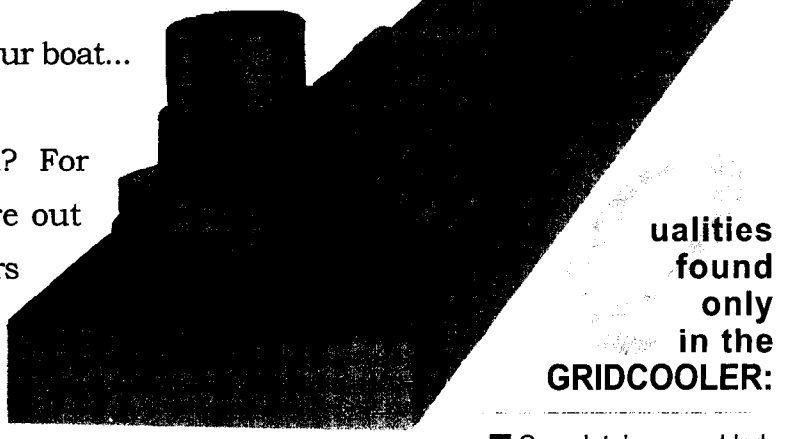

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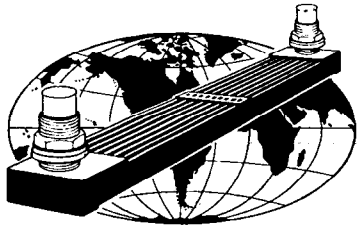

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CIRCLE 36 ON READER SERVICE CARD

The consolidations mean fewer competitors, resulting in less flexibility in pricing. Some industry experts see the proposed sale as a backlash against railroad mergers, and one that could lead to increased business for barge operators.

Barging is normally cheaper than rail. But, historically, a problem with barging has been the transportation costs involved in bringing the product from inland elevators to river loading sites. The acquisition, if approved, would give Cargill 27 additional barge-loading elevators along riverfronts and six port elevators.

Dr. Kevin Horn, a research professor and intermodal economist at Louisiana State University National Ports & Waterways Institute, Arlington, Va., said the purchase would open up new routes and provide alternatives to moving grain by rail. "Certainly, it would be sweet for Cargill to take (grain) off the rails."

Horn said railroad consolidations have narrowed the number of transportation markets available to buyers and sellers of grain. "Transportation options are valuable," he said. "This is a natural response from the grain companies. This is almost what the railroads deserve."

Transportation consultant Brent Dibner agreed that rail consolidations may have contributed to the impending sale. "It's a balance of terror," Dibner said. "Now the grain marketing business has a bigger player, and the railroads have to come to terms with Cargill."

Cargill, however, may not be able to handle all of the tonnage unless it purchases new equipment. Its barge unit, Cargo Carriers, boasts a fleet of about 1,200 covered hopper barges.

But industry experts say that may not be sufficient to carry the combined tonnage of Cargill and Continental. Continental sold its barge division, Conticarriers, to American Commercial Lines in 1995, then contracted ACL to haul Continental's grain for 10 years. That contract is expected to stay intact.

"Hopefully, Cargill will expand the market," said Peter Hubbard, senior vice president of marketing at Midland Enterprises, Cincinnati. "But it's hard to predict."

Another issue that's hard to predict is whether the proposed sale will be able to stand up to antitrust scrutiny. The National Farmers Union has come out against the sale, claiming it would shrink the number of buyers U.S. farmers could sell their grain to. The deal would give Cargill control of more than 40 percent of U.S. corn exports.

The Justice Department announced on Dec. 8 that it was investigating the sale.

— Ken Hocke

USCG to beef up recruiting efforts

For the last few years, the Coast Guard has been paring its ranks because of

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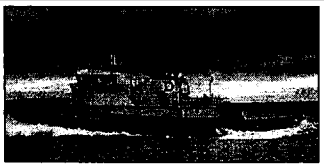

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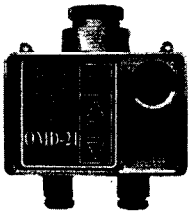

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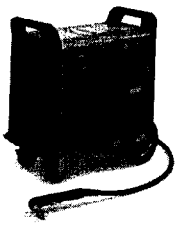

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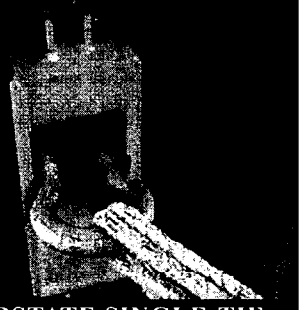

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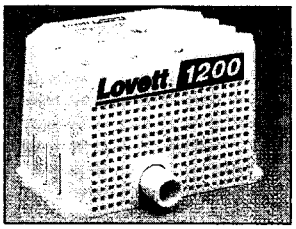

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Scanstrut Ltd., introduces the all new Composite Fiberglass PowerTowers. They are designed to solve the problem of installing radar and satcoms on radar arches and cabin roofs, by raising the antenna 14". Produced using the RTM process, The PowerTower mounts are lightweight and strong with a high gloss white finish. The small mounting footprint is ideal for narrow radar arches. A hollow core allows cables to be routed inside. Three models, fit practically all randomes, small satcoms and searchlights.

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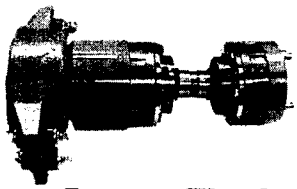

Python-Drive

Constant velocity drive units. The Python-Drive allows the propulsion system to push your boat, not your engine. This separates the vibration of the propeller from the vibration of the engine. The results are decreased vibration and noise delivering a smoother ride and longer equipment life. The Python-Drive drive eliminates the need for perfect shaft alignment. Systems are available for engines from 10 to 1000 horse power.

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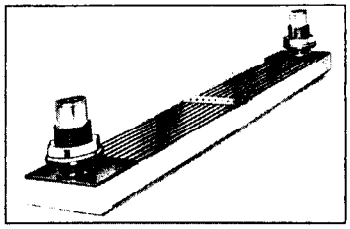

The Fernstrum GRIDCOOLER Keel Cooler is a closed-circuit cooling system engineered to meet your engine's cooling requirements and operating conditions. It is a durable, compact unit that comes completely assembled, made of 90/10 copper-nickel or 5000 series aluminum tubing. R.W. Fernstrum & Company has 50 years experience in cooling marine engines.

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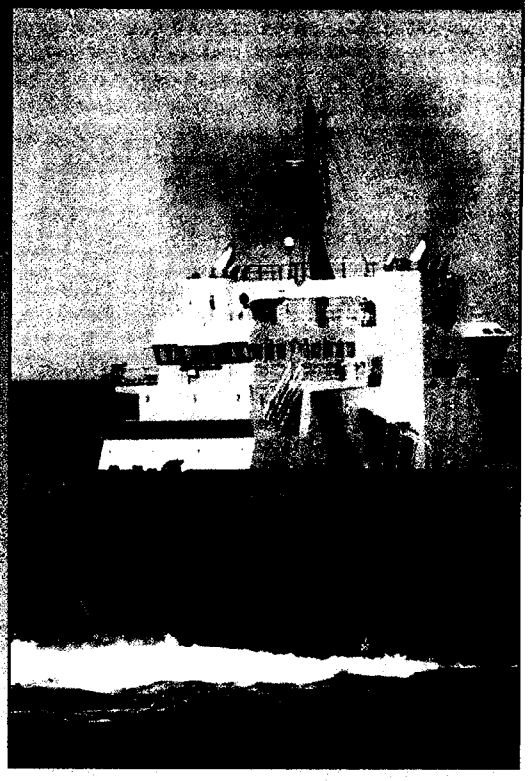
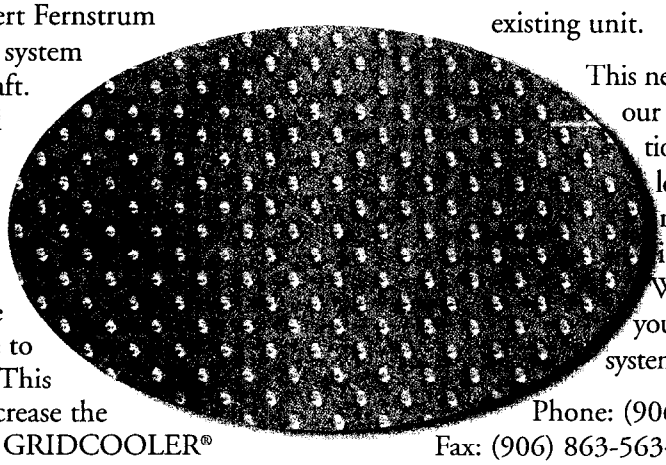
thought we couldn't cooler!



Introducing the ENHANCED GRIDCOOLER®, keel cooler from R.W. Fernstrum

In the early 1940s, Robert Fernstrum designed a keel cooling system for US military landing craft. Over the years, his original design has seen improvements in durability and efficiency.

For the latest improvement in efficiency, we have added an enhanced surface to the interior of our tubing. This new design allows us to increase the heat transfer capability of a GRIDCOOLER® keel cooler by up to 30%. On larger installations, the increase in efficiency gives the enhanced GRIDCOOLER unit the ability to handle a greater heat-load. In some cases, major modifications to the vessel's piping are unnecessary. Also, if it becomes necessary to modify an older vessel for a new use that requires additional cooling, (i.e. warmer sea water temperatures, slower hull speeds or adding antifreeze) we may be able to supply your vessel with an enhanced cooler of the same size as your existing unit.



This new advancement shows our commitment to innovation in a field where we've long been the leader. If you need a solution to a cooling problem, give us a call. We will gladly work with you to design a keel cooling system to meet your needs.

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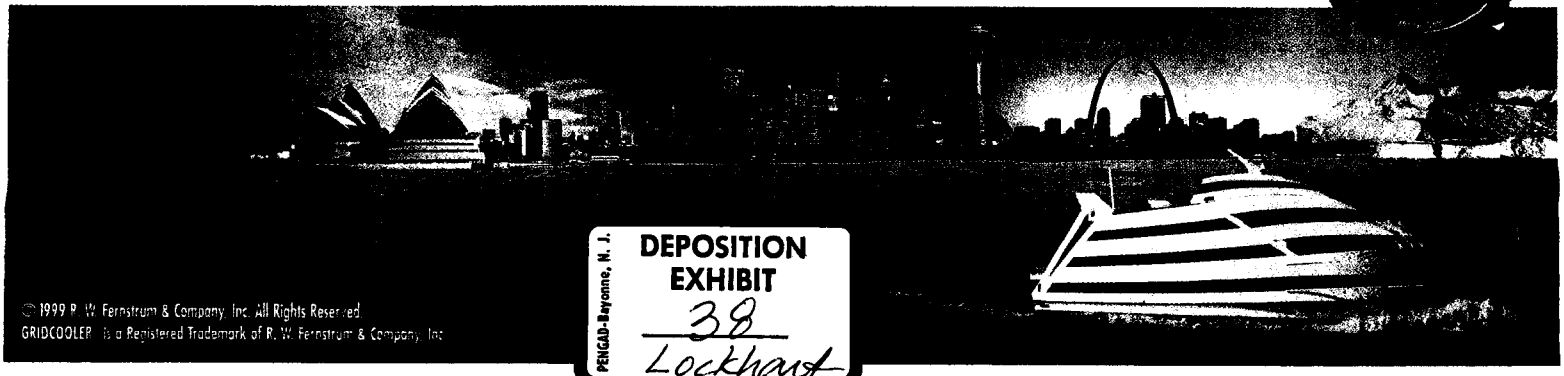


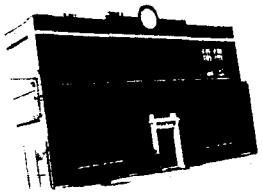
Catalog 2004

Quality, Durability, Efficiency

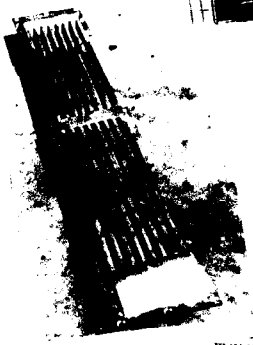
FERNSTRUM GRIDCOOLER®

ENGINEERED KEEL COOLING

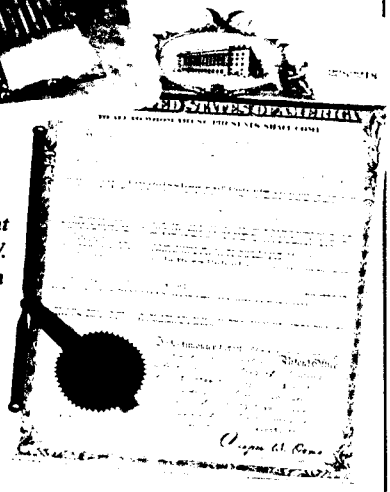
The Fernstrum Story



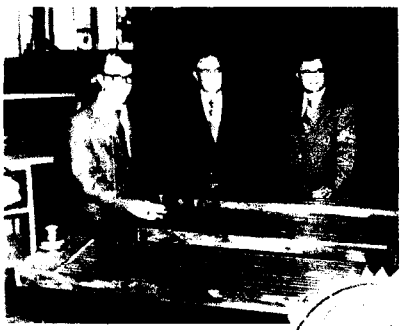
1938 - Marine ducts Company



1943 - Angle head keel cooler



1945 - Patent ssued to R.W. Fernstrum



1971 - Showing off models of their GRIDCOOLER® keel coolers are (left to right) Paul W. Fernstrum, R.W. Fernstrum and David J. Fernstrum

The History of R.W. FERNSTRUM & CO.

R.W. Fernstrum & Co. is a business built on innovation. Ever since our founder, Robert W. Fernstrum, patented the first rectangular tube keel cooler with an angled header back in 1945, we've continued the tradition of bringing the latest keel cooling technology to the marine industry. Even after 50 years, you'll still find the Fernstrum family at the helm of the company, ensuring that our GRIDCOOLER® keel coolers provide you with the best in efficiency, quality and ease of installation.

1938 - Robert W. Fernstrum starts Marine Products Company.

1945 - Patent is issued to R.W. Fernstrum for keel cooler. Use of Fernstrum keel coolers begins in the military.

1950s - Oil industry and shrimp fleet incorporate Fernstrum GRIDCOOLER® keel coolers into their designs.

1952 - Use of Fernstrum keel cooler begins in Navy mine sweepers.

1960 - First flanged coolers produced.

1964 - Fernstrum GRIDCOOLER® keel coolers used on Ann Arbor car ferry — first diesel electric—the largest keel cooler to date (6 feet longer than the 120 used in the oil industry).

1969 - New steel building constructed gives Fernstrum an additional 6,000 square feet of manufacturing space.

1971 - Header design enlarged for added

1973 - Manufacturing facility expands an additional 4,000 square feet.

1975 - Fernstrum engineers develop their first computer model for recommending GRIDCOOLER® keel coolers. Additional 6,000 square feet added to manufacturing facility.

1976 - Fernstrum brings all operations (manufacture and assembly of product) under one roof.

1980 - 500th GRIDCOOLER® keel cooler model becomes available.

1981 - Aluminum Series GRIDCOOLER® keel cooler is introduced. Office building expansion doubles space. Additional 6,000 square feet added to manufacturing facility.

1982 - Patent is issued for Stacked Tube GRIDCOOLER® keel cooler.

1990 - Product line grows to 20,000 models.

1993 - R.W. Fernstrum announces 23 distributors world-wide.

1998 - The Z-Series GRIDCOOLER® keel cooler is introduced.

1999 - Enhanced Tube™ GRIDCOOLER® keel cooler goes into production

1999 - Fernstrum receives patent for Low Profile header.

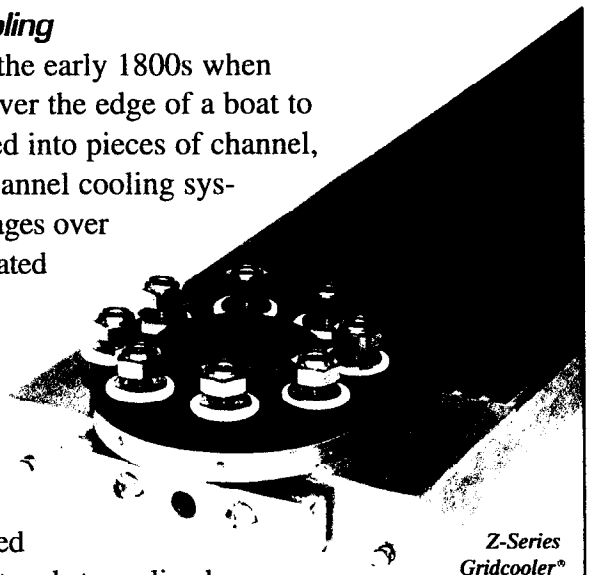
1999 - R.W. Fernstrum celebrates 50 years in business and remains the premier manufacturer of keel coolers.

2000 - R.W. Fernstrum begins 2-year warranty program. Over 100,000 models of GRIDCOOLER® keel coolers available.

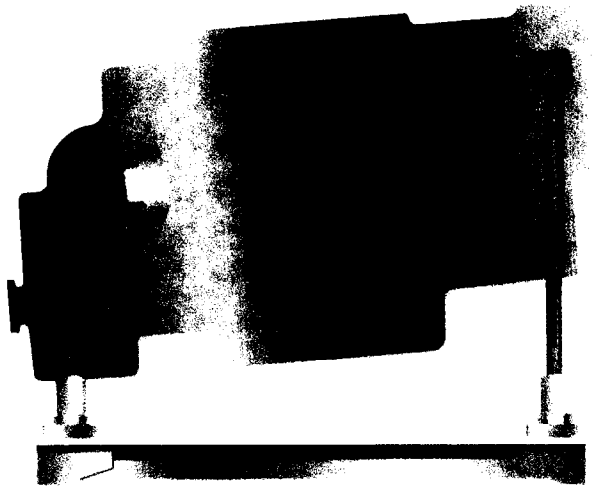
2001 - Enhancements in durability and coolant flow. Investments in new CNC fabrication equipment and building

A Brief History of Keel Cooling

Keel cooling first appeared in the early 1800s when someone hung a copper tube over the edge of a boat to condense steam. It later evolved into pieces of channel, welded onto the hull. These channel cooling systems offered important advantages over raw water cooling. They eliminated silt and sand buildup in engine jackets and protected engines against salt water corrosion. Unfortunately, their sheer bulk reduced a ship's capacity and increased its drag. They were also prone to seaweed foulup. Clearly, a more compact and streamlined cooler was needed. This led to packaged keel coolers and the R.W. FERNSTRUM success story.



Z-Series Gridcooler® keel cooler

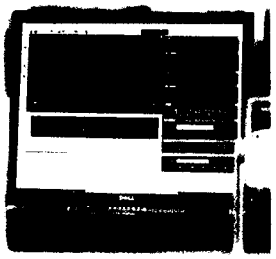


Engine jacket water is piped directly to the Fernstrum GRIDCOOLER® keel cooler, which cools the water and then sends it back to the engine. The GRIDCOOLER® keel cooler is in constant contact with the sea water for transfer of heat.

Engineered Keel Cooling

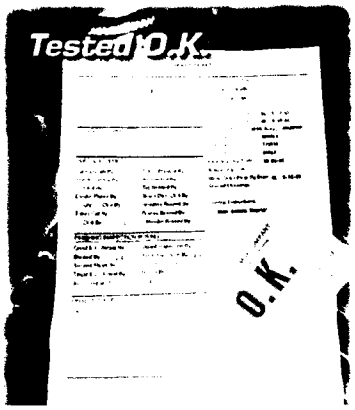
When you choose a Fernstrum GRIDCOOLER® keel cooler, you're getting more than well-built hardware. You're getting the most cost-effective, dependable form of keel cooling available — backed by decades of experience. We're proud of our reputation, and we work hard to keep it.

To ensure that you get precisely what you need, we begin by asking a lot of questions. We'll need to know your engine make and model number, horsepower and rpm rating, heat rejection, freshwater flow rate, and the temperature requirements of the water entering and leaving the cooler. If you don't have all this information, we'll get it for you — we maintain current files on all major marine engine manufacturers. We'll also need your vessel's hull design, it's maximum speed at full rated power, and the maximum water temperature in which it will operate. With this data, we can determine exactly what size GRIDCOOLER® keel coolers your vessel will need — under it's most severe operating conditions



Ongoing product research and development studies ensure continual improvement in efficiency, durability and qualit

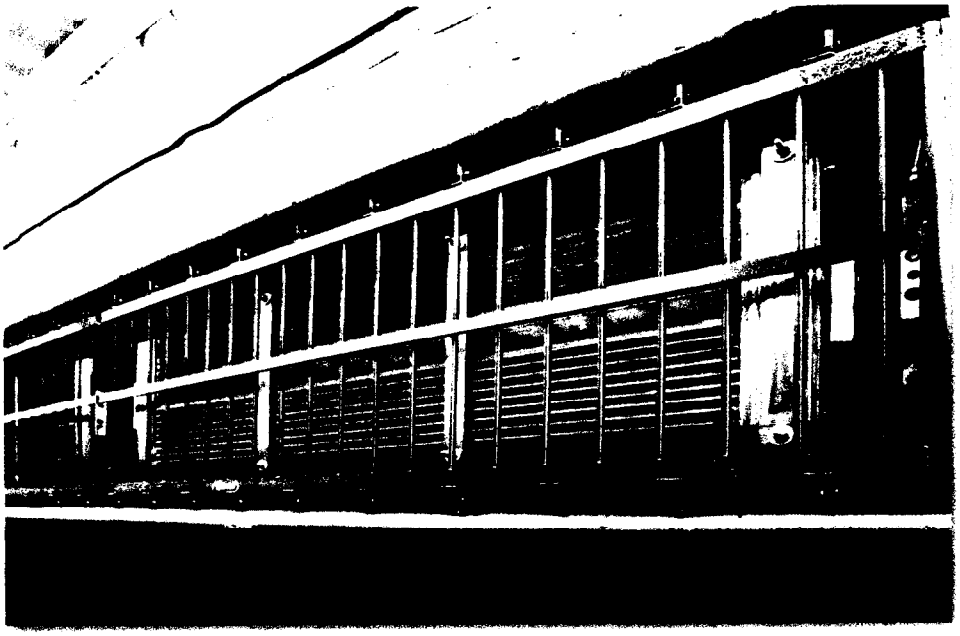
A Look at Fernstrum Quality



Quality and Testing Methods

- Only the finest quality materials are used in manufacturing a Fernstrum GRIDCOOLER® keel cooler. Much of the materials used have metallurgical specifications proprietary to Fernstrum, based on decades of manufacturing experience — enhancing the durability and performance of the product.
- Quality control begins as soon as material is received. All material is 100 percent inspected. No random sampling methods are used. After inspection, raw material is assigned lot numbers for traceability throughout the manufacturing process.
- For customer protection, each unit is assigned its own serial number and inspection sheet. The inspection sheet tracks material lot numbers and the results of all testing throughout production. Additionally, employee identification is recorded for each step through the production process.
- Experienced craftsmen use only the finest silver brazing alloys. Less expensive materials do not meet Fernstrum's high quality standards.
- Multiple quality assurance checks are made throughout the production process — including two separate underwater air tests to assure the integrity of brazed or welded joints.
- Cleanup by sandblasting is done in a specially constructed semi-automatic blasting cabinet.
- Ultrasonic testing is used to check the brazed joints of each unit to assure that every GRIDCOOLER® keel cooler is of superior strength. Each unit is checked for dimensional accuracy, square and straightness.
- On successful completion of all quality checks, each unit receives its own Quality Assurance tag — your assurance of excellence!
- Each unit is carefully boxed in a triple-corrugated, weather resistant fiberboard. Special wood crating is available for long-term storage upon request.
- Each GRIDCOOLER® keel cooler is shipped with all the gaskets, washers and nuts necessary for installation, as well as with installation suggestions.

Angled Tube GRIDCOOLER®

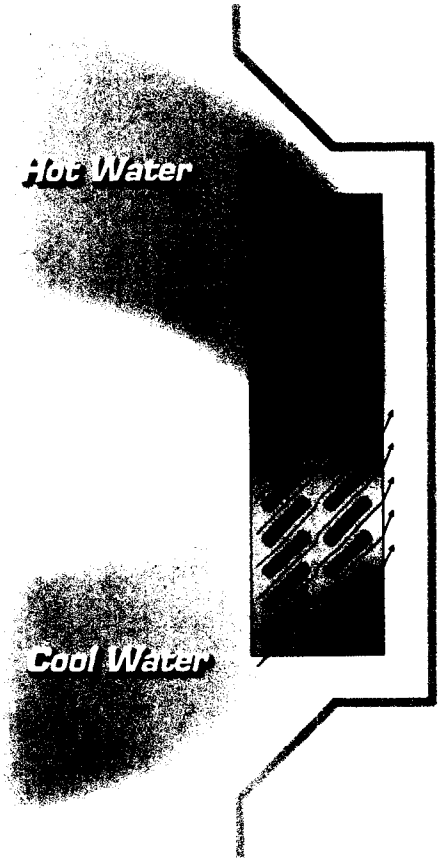


The Angled Tube GRIDCOOLER® keel cooler... Meeting the needs of stationary vessels

Traditional keel cooling methods have been applied to stationary vessels for decades. R.W. Fernstrum & Company introduces an innovation that will benefit dredges, stationary operating generators and similar equipment. While most keel coolers are designed to transfer heat to the slipstream current of the seawater while the vessel is underway, the angled tube GRIDCOOLER® keel cooler is designed to take advantage of buoyancy driven flow of seawater created through mixed convection while the vessel is at rest. The angled tube design also provides the added benefit of being less likely to become a resting place for silt and other debris, which retard heat transfer.

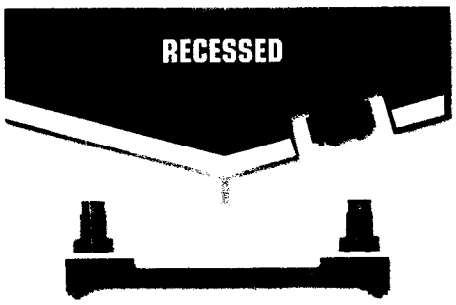
The angled tube GRIDCOOLER® keel cooler takes advantage of many of the characteristics that have made the standard GRIDCOOLER® keel cooler popular. Simplicity, durability and compact form, combined with increased heat transfer efficiency, make this new design attractive to stationary and low-speed applications.

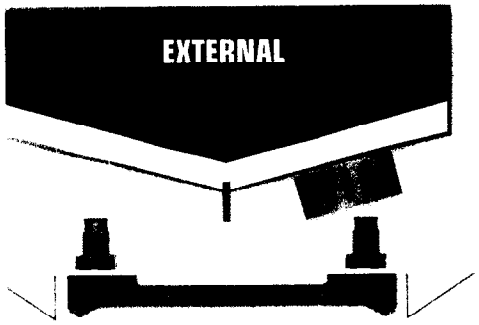
Furthermore, the availability of both smooth wall and Fernstrum's exclusive enhanced tubing allow for greater design flexibility in creating the most

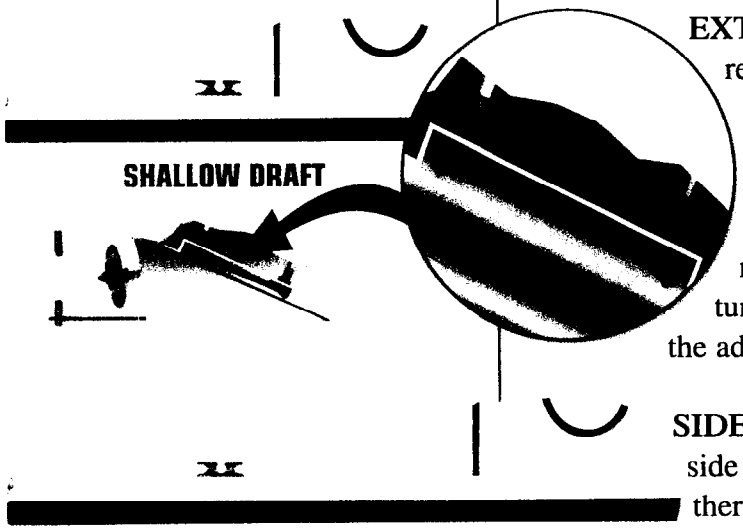


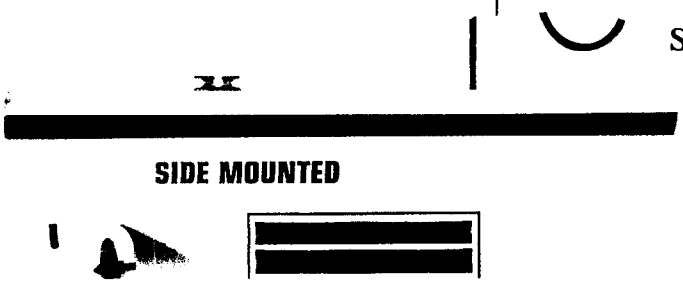
The angled tube GRIDCOOLER® keel cooler has tubes positioned to enhance and exploit the natural convection current generated by the heat exchanger.

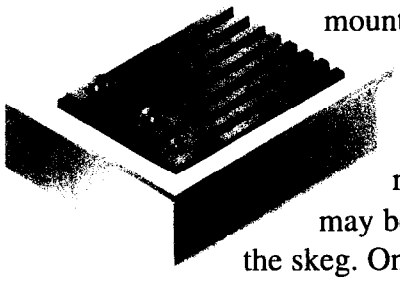
Common Installations











The Fernstrum GRIDCOOLER® keel cooler can be mounted almost anywhere on a ship's hull, giving the flexibility to match the installation to the hull design and operating conditions of any boat. For example; on shallow draft river work boats, the GRIDCOOLER® unit may be mounted on the side of the hull or beside the skeg. On towboats, the GRIDCOOLER® unit may be installed near the propeller to take advantage of its slipstream during heavy towing. On fast moving vessels, the unit is normally recessed along side the keel. See the Fernstrum GRIDCOOLER® keel cooler installation guide for more information.

RECESSED — Recessing a GRIDCOOLER® keel cooler streamlines the installation and greatly increases protection from damage. Independent tests conducted at the Vienna Model Test Basin have shown that drag is negligible when GRIDCOOLER® keel coolers are recessed into a ship's hull. If possible, the ends of the recess should be flared to allow a free flow of water over the entire cooler.

EXTERNAL — If the GRIDCOOLER® keel cooler can't be recessed, fairing blocks and side plates may be used for protection and streamlining.

SHALLOW DRAFT — Because of their compact size, Fernstrum GRIDCOOLER® keel coolers may be mounted along the keel or skeg, or even in the rake or tunnel of shallow draft river boats. This takes advantage of the additional water current created by the propeller.

SIDE MOUNTED — GRIDCOOLER® keel coolers may be side mounted to avoid damage due to running aground or if there isn't room for a bottom mount to the hull.

Custom Configurations

The Fernstrum GRIDCOOLER® is available in standard as well as many custom configurations to accommodate installation and maintenance concerns. Custom designs are a Fernstrum specialty and are limited only by imagination. We are happy to discuss your application and assist in designing or determining a custom configuration that adds value to your cooling system. Some of the more common configurations are listed.

E-SERIES® GRIDCOOLER® keel coolers have zinc anodes mounted at the ends of the units. This modification is available upon request at no additional charge and works well for fishing vessels where entanglement of nets is a concern.

EXTENDED NOZZLES may be ordered for vessels with thick hulls.

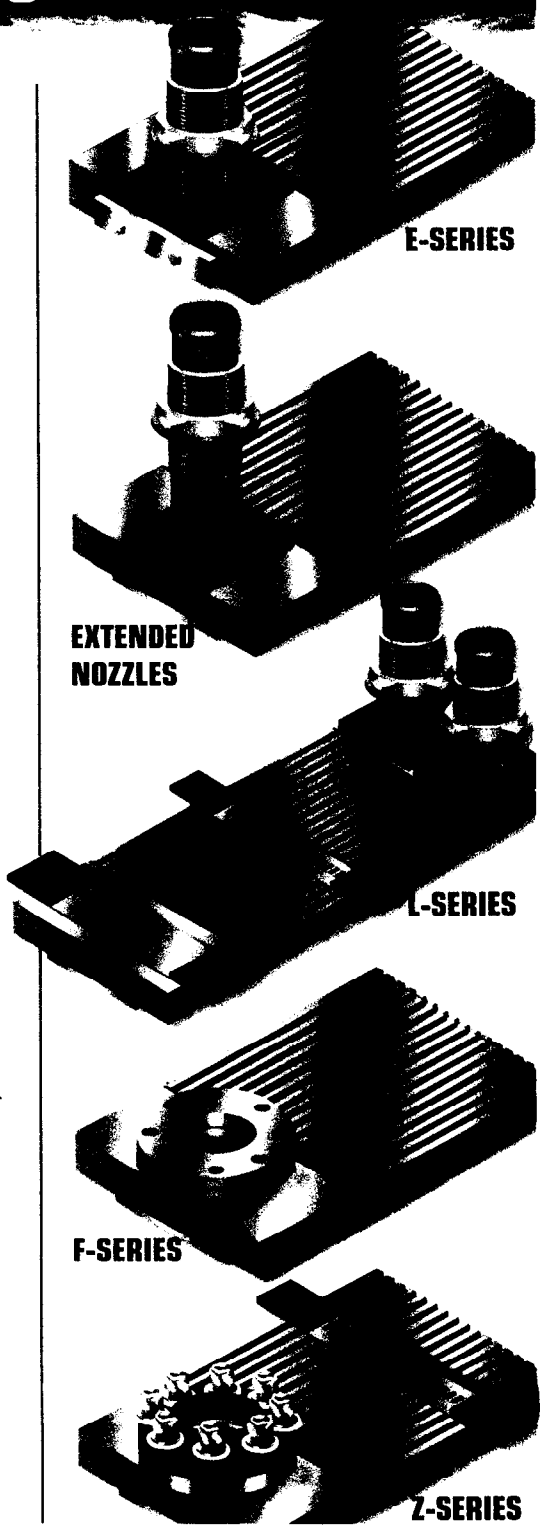
L-SERIES® GRIDCOOLER® keel coolers (shown here in multi-pass configuration) with extended support plates reduce the number of hull penetrations needed for installation.

F-SERIES® GRIDCOOLER® keel coolers have flange connections and may eliminate the need for cofferdams.

Z-SERIES® GRIDCOOLER® keel coolers have lower profile flange connections with all mounting hardware and mating flanges included. Custom insulators provide isolation from the hull, if necessary. L-Series support plates are included as standard in this configuration. This patent-pending design eases installation on double hulled vessels and may eliminate the need for cofferdams.

MATERIALS — Fernstrum **GRIDCOOLER®** keel coolers are available in either 90/10 copper-nickel or marine grade aluminum rectangular tubing. Copper/nickel units have natural anti-foulant properties. The tubing is very ductile, so it can be slightly bent or twisted to conform to the ship's hull. Aluminum units are made of alloys that are compatible with vessels having aluminum hulls.

COMPRESSION SEALING HARDWARE is available upon request to help assure a leak-free seal at the nozzles and is recommended for customers utilizing cofferdams in their installation.



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DURAWELD®

Keel Coolers

[redacted]

Telephone: 504-876-3120
504-876-6944
Fax: 504-876-0305

DURAWELD®
Keel Coolers

Mission Statement

East Park Radiator is committed to providing impeccable quality and service to its customers through continued research, design and testing of its own products and the other products it services for the marine and oilfield industry.

DURAWELD®
Keel Coolers

History

East Park Radiator was started in 1962 as a radiator repair and battery facility. Since its inception, East Park Radiator has evolved into a major repair facility servicing radiators, tube and shell heat exchangers, aftercoolers, inner coolers, air exchanger and keel coolers for the marine and oilfield industry. After years of extensive keel cooler repairs, East Park Radiator has applied its knowledge and experience into developing its own keel cooler known as the DURAWELD® Keel Cooler. East Park Radiator obtained insight, through the failures and the concerns of its customers that resulted in several significant changes to its DURAWELD® Keel Cooler. These changes resulted in a higher quality durable product with an exceptionally fast delivery time.

DURAWELD®
Keel Coolers

- Welded Construction For Dependability & Durability
- Seamless 90/10 Copper-Nickel Rectangular Tubes
  - With 0.070" Wall Thickness
  - Exceptional Heat Transfer Properties
  - Excellent Corrosion/Erosion Resistance To The Effects Of Sea Water
  - Exceptional Anti-Fouling Capabilities
- Many Models Available
  - Interchangeable With The Competition
- Each Unit Equipped With Cathodic Protection
- Before Delivery; Each Unit Is Assembled, Pressure Tested And Hydrostatically Tested
- Full Scale Heat Transfer Dynamometer
- Continued Research, Design And Testing Of Keel Coolers
  Example: Flange Mounted Keel Coolers To Be In Full Production Soon
- Redesigned manifold to improve water flow and pressure drops
- Full Line Of Replacement Parts In Stock
- Services:
  - 24 Hour Emergency Delivery Upon Request (Subject To Prior Sale)
  - Clean & Repair Of All Makes And Models Of Keel Coolers

Duraweld® Keel Cooler

0008 SERIES
SINGLE PASS

MODEL	A	B	C	D	E
0408	31 1/4	24	- - -	- - -	32 5/8
0508	37 1/4	30	- - -	- - -	38 5/8
0608	43 1/4	36	- - -	- - -	44 5/8
0708	49 1/4	42	- - -	- - -	50 5/8
0808	55 1/4	48	- - -	- - -	56 5/8
0908	61 1/4	54	- - -	- - -	62 5/8
1008	67 1/4	60	- - -	- - -	68 5/8
1108	73 1/4	66	1	33	74 5/8
1208	79 1/4	72	1	36	80 5/8
1308	85 1/4	78	1	39	86 5/8
1408	91 1/4	84	1	42	92 5/8
1508	97 1/4	90	2	30	98 5/8
1608	103 1/4	96	2	32	104 5/8
1708	109 1/4	102	2	34	110 5/8
1808	115 1/4	108	2	36	116 5/8
1908	121 1/4	114	2	38	122 5/8
2008	127 1/4	120	2	40	128 5/8
2208	139 1/4	132	2	44	140 5/8
2408	151 1/4	144	2	48	152 5/8
2608	163 1/4	156	2	52	164 5/8
2808	175 1/4	168	3	42	176 5/8
3008	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES.

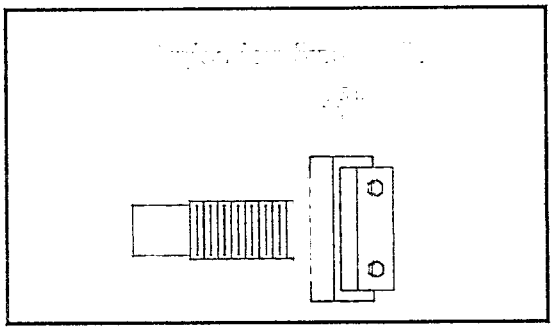
MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

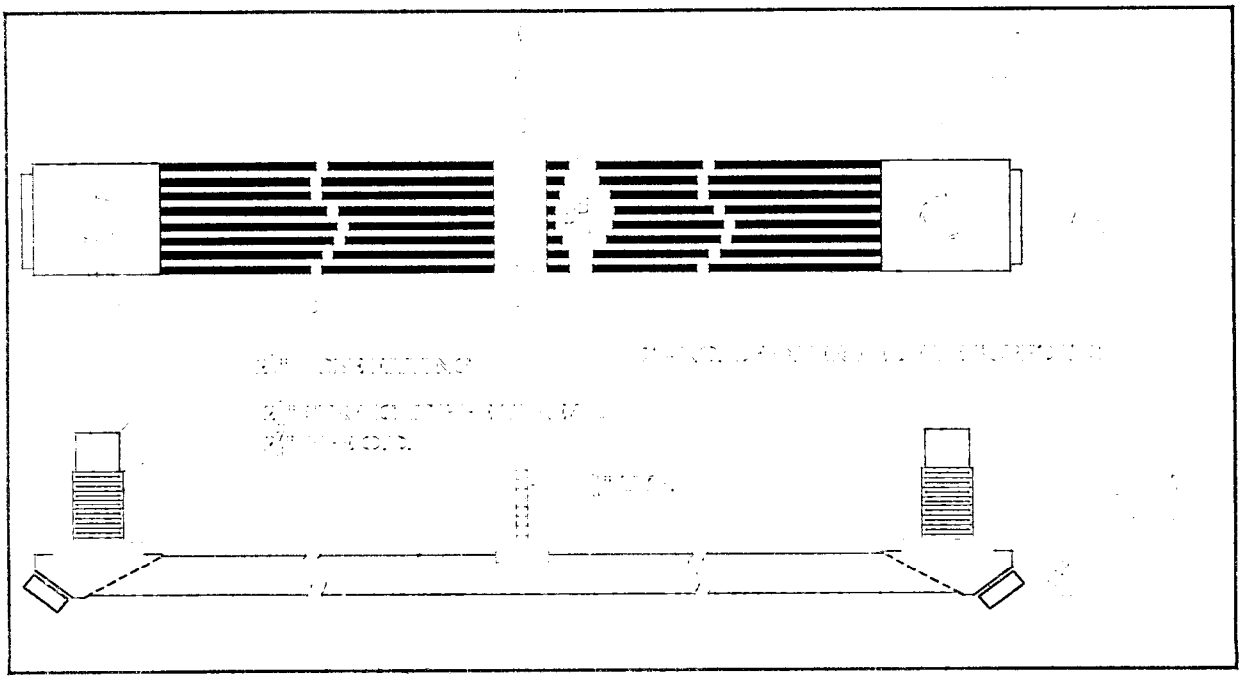
OVERALL LENGTH + 3 INCHES

OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.





Duraweld® Keel Cooler

0010 SERIES
SINGLE PASS

MODEL	A	B	C	D	E
0410	31 1/4	24	- -	- - -	32 5/8
0510	37 1/4	30	- -	- - -	38 5/8
0610	43 1/4	36	- -	- - -	44 5/8
0710	49 1/4	42	- -	- - -	50 5/8
0810	55 1/4	48	- -	- - -	56 5/8
0910	61 1/4	54	- -	- - -	62 5/8
1010	67 1/4	60	- -	- - -	68 5/8
1110	73 1/4	66	1	33	74 5/8
1210	79 1/4	72	1	36	80 5/8
1310	85 1/4	78	1	39	86 5/8
1410	91 1/4	84	1	42	92 5/8
1510	97 1/4	90	2	30	98 5/8
1610	103 1/4	96	2	32	104 5/8
1710	109 1/4	102	2	34	110 5/8
1810	115 1/4	108	2	36	116 5/8
1910	121 1/4	114	2	38	122 5/8
2010	127 1/4	120	2	40	128 5/8
2210	139 1/4	132	2	44	140 5/8
2410	151 1/4	144	2	48	152 5/8
2610	163 1/4	156	2	52	164 5/8
2810	175 1/4	168	3	42	176 5/8
3010	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES.

MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES

OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

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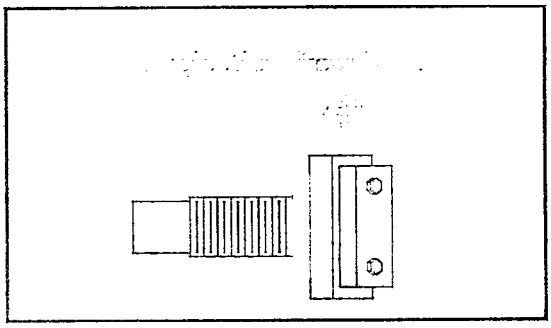

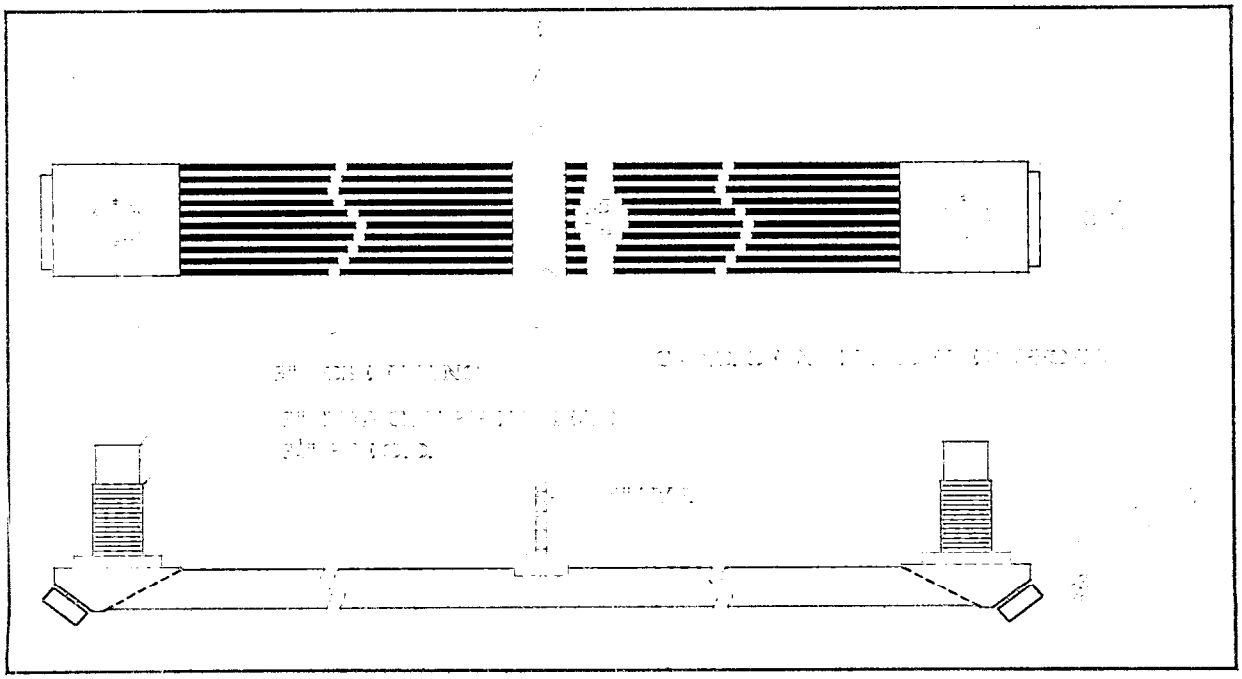

Duraweld® Keel Cooler

0012 SERIES
SINGLE PASS

MODEL	A	B	C	D	E
0412	31 1/4	24	- -	- -	32 5/8
0512	37 1/4	30	- -	- -	38 5/8
0612	43 1/4	36	- -	- -	44 5/8
0712	49 1/4	42	- -	- -	50 5/8
0812	55 1/4	48	- -	- -	56 5/8
0912	61 1/4	54	- -	- -	62 5/8
1012	67 1/4	60	- -	- -	68 5/8
1112	73 1/4	66	1	33	74 5/8
1212	79 1/4	72	1	36	80 5/8
1312	85 1/4	78	1	39	86 5/8
1412	91 1/4	84	1	42	92 5/8
1512	97 1/4	90	2	30	98 5/8
1612	103 1/4	96	2	32	104 5/8
1712	109 1/4	102	2	34	110 5/8
1812	115 1/4	108	2	36	116 5/8
1912	121 1/4	114	2	38	122 5/8
2012	127 1/4	120	2	40	128 5/8
2212	139 1/4	132	2	44	140 5/8
2412	151 1/4	144	2	48	152 5/8
2612	163 1/4	156	2	52	164 5/8
2812	175 1/4	168	3	42	176 5/8
3012	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES.

MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES

OVERALL WIDTH + 3 INCHES

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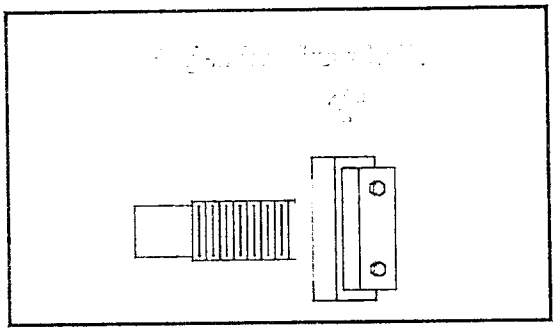

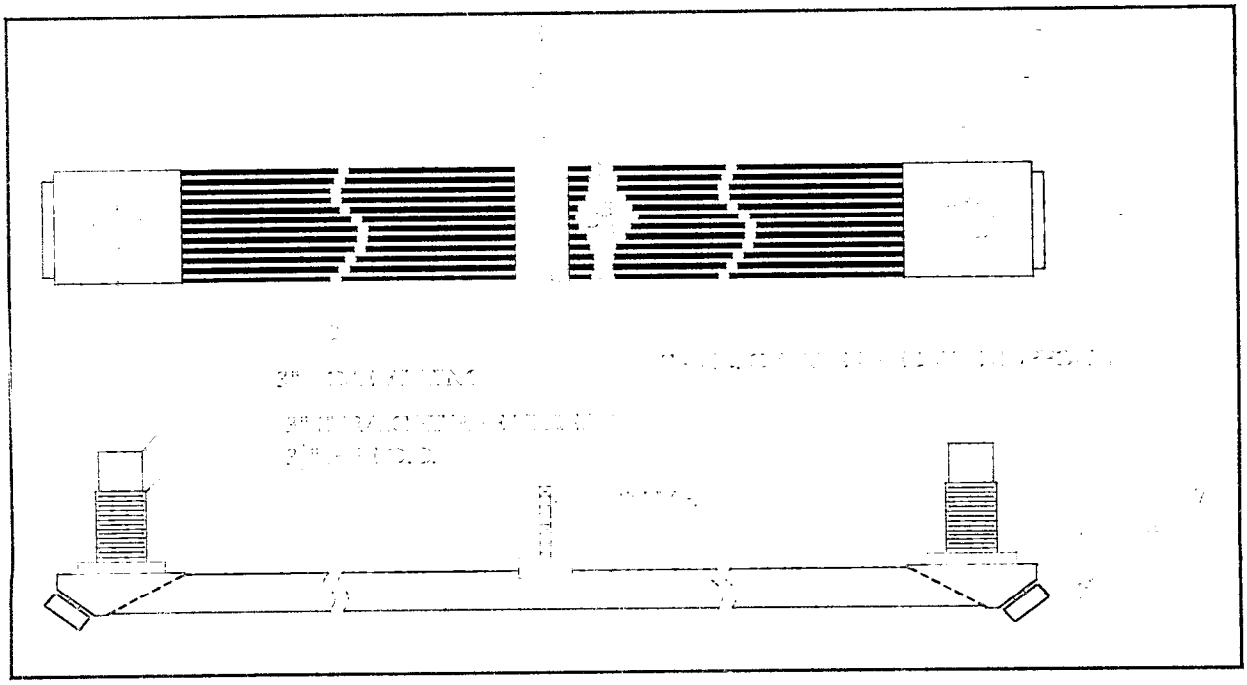

Duraweld® Keel Cooler

0014 SERIES
SINGLE PASS

MODEL	A	B	C	D	E
0414	31 1/4	24	- -	- - -	32 5/8
0514	37 1/4	30	- -	- - -	38 5/8
0614	43 1/4	36	- -	- - -	44 5/8
0714	49 1/4	42	- -	- - -	50 5/8
0814	55 1/4	48	- -	- - -	56 5/8
0914	61 1/4	54	- -	- - -	62 5/8
1014	67 1/4	60	- -	- - -	68 5/8
1114	73 1/4	66	1	33	74 5/8
1214	79 1/4	72	1	36	80 5/8
1314	85 1/4	78	1	39	86 5/8
1414	91 1/4	84	1	42	92 5/8
1514	97 1/4	90	1	45	98 5/8
1614	103 1/4	96	2	32	104 5/8
1714	109 1/4	102	2	34	110 5/8
1814	115 1/4	108	2	36	116 5/8
1914	121 1/4	114	2	38	122 5/8
2014	127 1/4	120	2	40	128 5/8
2214	139 1/4	132	2	44	140 5/8
2414	151 1/4	144	2	48	152 5/8
2614	163 1/4	156	2	52	164 5/8
2814	175 1/4	168	3	42	176 5/8
3014	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES.

MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES
OVERALL WIDTH + 3 INCHES

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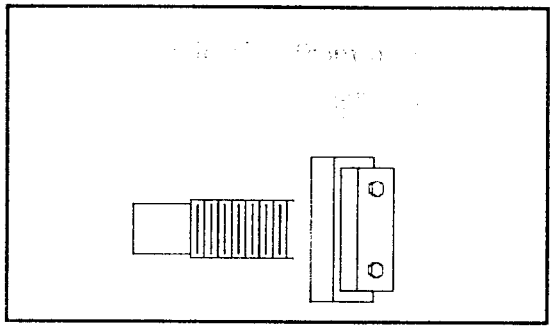

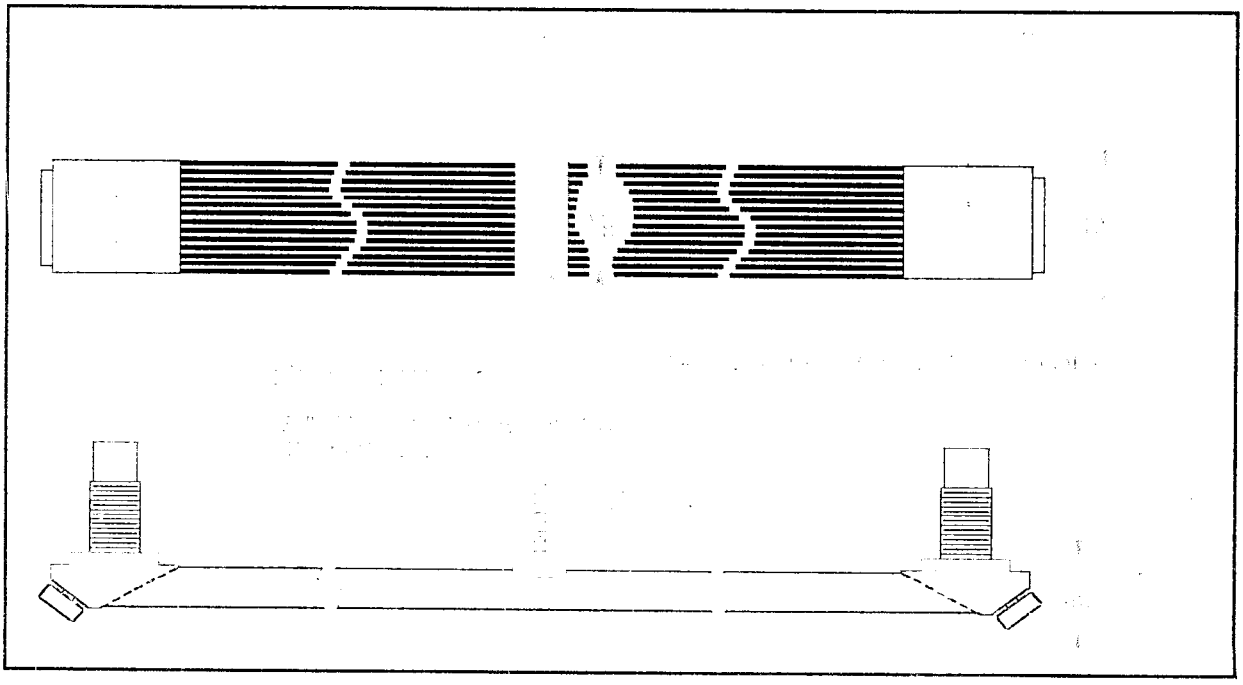

Duraweld® Keel Cooler

0016 SERIES
SINGLE PASS

MODEL	A	B	C	D	E
0416	31 1/4	24	- -	- - -	32 5/8
0516	37 1/4	30	- -	- - -	38 5/8
0616	43 1/4	36	- -	- - -	44 5/8
0716	49 1/4	42	- -	- - -	50 5/8
0816	55 1/4	48	- -	- - -	56 5/8
0916	61 1/4	54	- -	- - -	62 5/8
1016	67 1/4	60	- -	- - -	68 5/8
1116	73 1/4	66	1	33	74 5/8
1216	79 1/4	72	1	36	80 5/8
1316	85 1/4	78	1	39	86 5/8
1416	91 1/4	84	1	42	92 5/8
1516	97 1/4	90	1	45	98 5/8
1616	103 1/4	96	2	32	104 5/8
1716	109 1/4	102	2	34	110 5/8
1816	115 1/4	108	2	36	116 5/8
1916	121 1/4	114	2	38	122 5/8
2016	127 1/4	120	2	40	128 5/8
2216	139 1/4	132	2	44	140 5/8
2416	151 1/4	144	2	48	152 5/8
2616	163 1/4	156	2	52	164 5/8
2816	175 1/4	168	3	42	176 5/8
3016	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES.

MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES

OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

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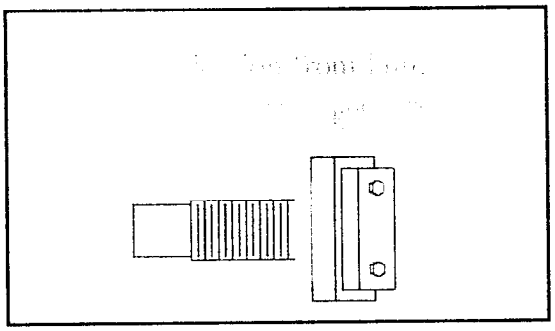
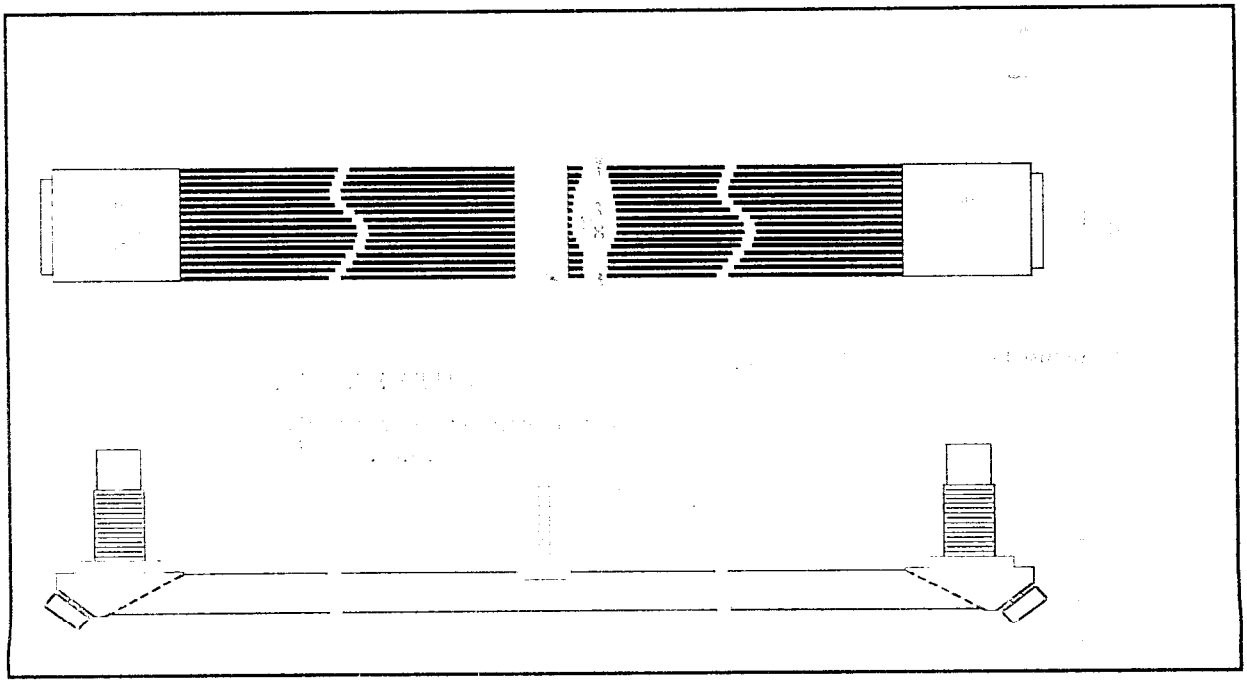




Duraweld® Keel Cooler

0018 SERIES
SINGLE PASS

MODEL	A	B	C	D	E
0418	31 1/4	24	- -	- - -	32 5/8
0518	37 1/4	30	- -	- - -	38 5/8
0618	43 1/4	36	- -	- - -	44 5/8
0718	49 1/4	42	- -	- - -	50 5/8
0818	55 1/4	48	- -	- - -	56 5/8
0918	61 1/4	54	- -	- - -	62 5/8
1018	67 1/4	60	- -	- - -	68 5/8
1118	73 1/4	66	1	33	74 5/8
1218	79 1/4	72	1	36	80 5/8
1318	85 1/4	78	1	39	86 5/8
1418	91 1/4	84	1	42	92 5/8
1518	97 1/4	90	1	45	98 5/8
1618	103 1/4	96	2	32	104 5/8
1718	109 1/4	102	2	34	110 5/8
1818	115 1/4	108	2	36	116 5/8
1918	121 1/4	114	2	38	122 5/8
2018	127 1/4	120	2	40	128 5/8
2218	139 1/4	132	2	44	140 5/8
2418	151 1/4	144	2	48	152 5/8
2618	163 1/4	156	2	52	164 5/8
2818	175 1/4	168	3	42	176 5/8
3018	187 1/4	180	3	45	188 5/8

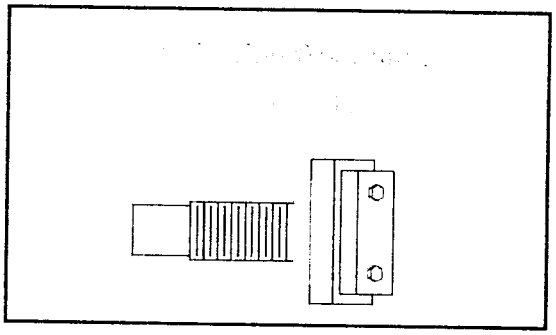
ALL DIMENSIONS ARE IN INCHES.

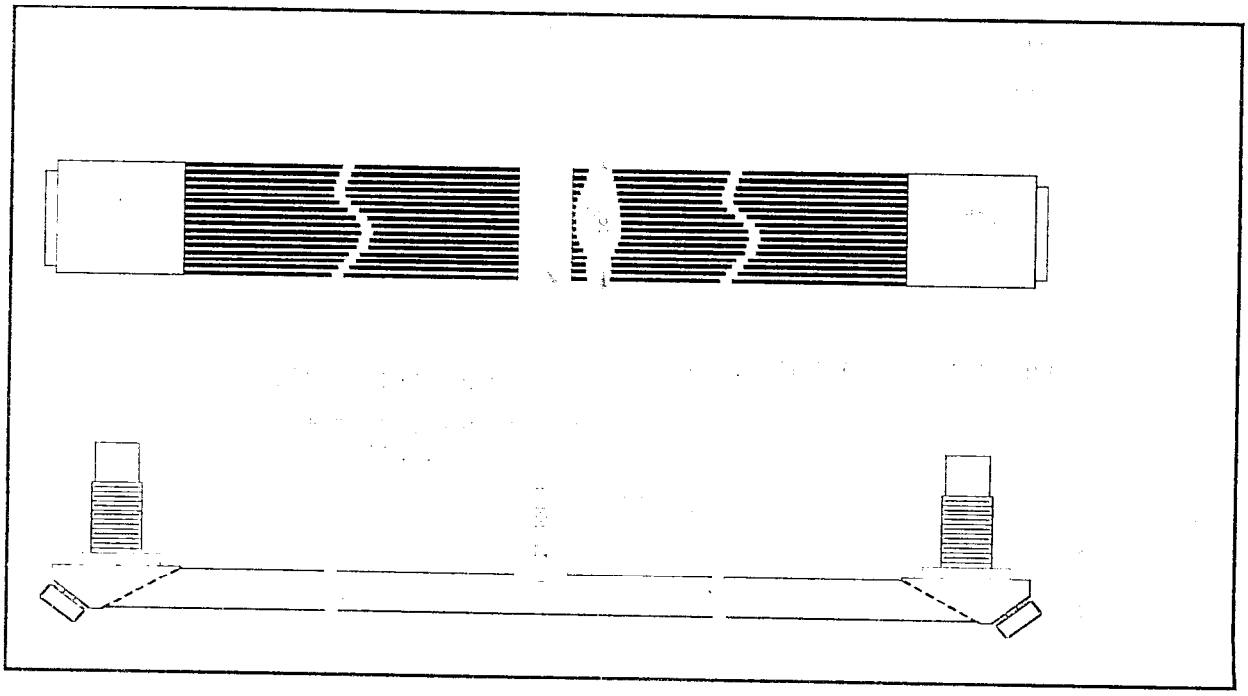
MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES
OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.





Duraweld® Keel Cooler

0020 SERIES
SINGLE PASS

MODEL	A	B	C	D	E
0420	31 1/4	24	- -	- - -	32 5/8
0520	37 1/4	30	- -	- - -	38 5/8
0620	43 1/4	36	- -	- - -	44 5/8
0720	49 1/4	42	- -	- - -	50 5/8
0820	55 1/4	48	- -	- - -	56 5/8
0920	61 1/4	54	- -	- - -	62 5/8
1020	67 1/4	60	- -	- - -	68 5/8
1120	73 1/4	66	1	33	74 5/8
1220	79 1/4	72	1	36	80 5/8
1320	85 1/4	78	1	39	86 5/8
1420	91 1/4	84	1	42	92 5/8
1520	97 1/4	90	1	45	98 5/8
1620	103 1/4	96	2	32	104 5/8
1720	109 1/4	102	2	34	110 5/8
1820	115 1/4	108	2	36	116 5/8
1920	121 1/4	114	2	38	122 5/8
2020	127 1/4	120	2	40	128 5/8
2220	139 1/4	132	2	44	140 5/8
2420	151 1/4	144	2	48	152 5/8
2620	163 1/4	156	2	52	164 5/8
2820	175 1/4	168	3	42	176 5/8
3020	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES.

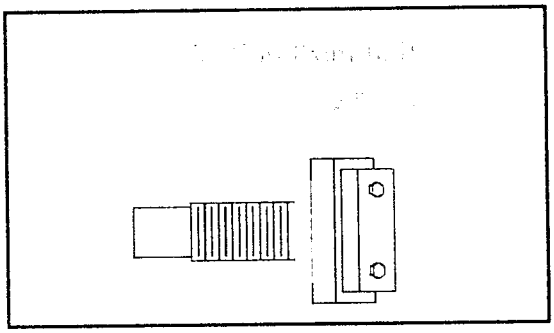
MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

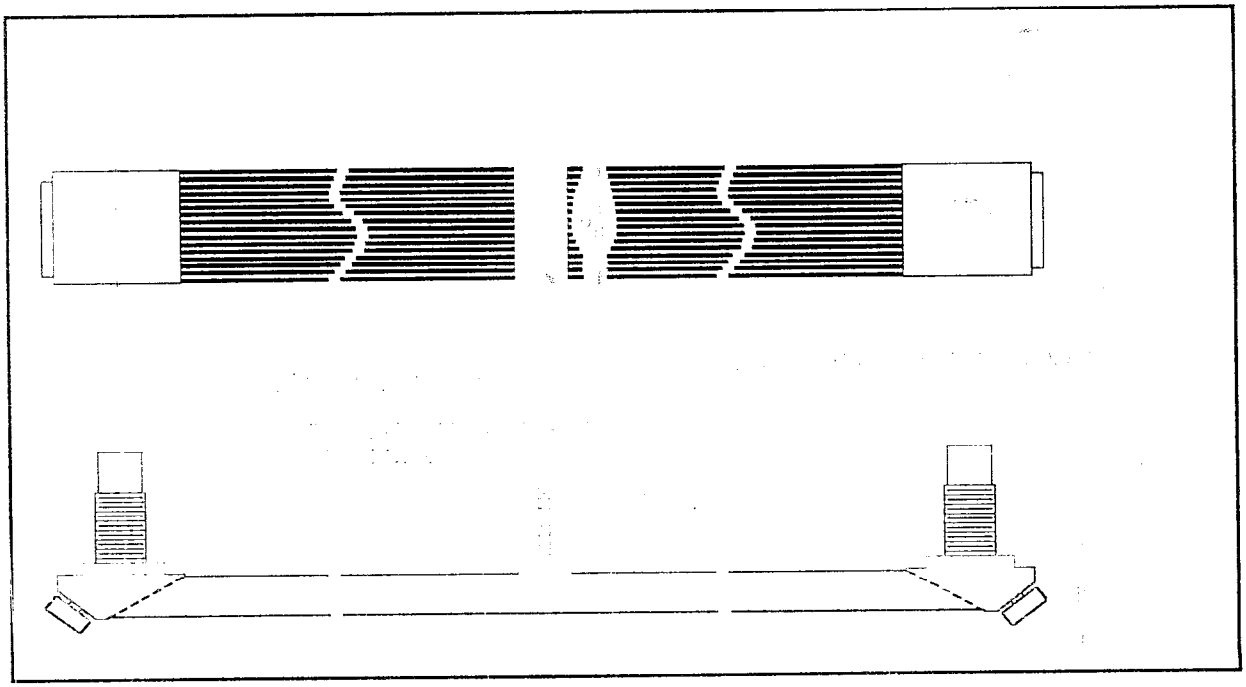
OVERALL LENGTH + 3 INCHES

OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.





Duraweld® Keel Cooler

0022 SERIES
SINGLE PASS

MODEL	A	B	C	D	E
0422	31 1/4	24	- -	- - -	32 5/8
0522	37 1/4	30	- -	- - -	38 5/8
0622	43 1/4	36	- -	- - -	44 5/8
0722	49 1/4	42	- -	- - -	50 5/8
0822	55 1/4	48	- -	- - -	56 5/8
0922	61 1/4	54	- -	- - -	62 5/8
1022	67 1/4	60	- -	- - -	68 5/8
1122	73 1/4	66	1	33	74 5/8
1222	79 1/4	72	1	36	80 5/8
1322	85 1/4	78	1	39	86 5/8
1422	91 1/4	84	1	42	92 5/8
1522	97 1/4	90	1	45	98 5/8
1622	103 1/4	96	2	32	104 5/8
1722	109 1/4	102	2	34	110 5/8
1822	115 1/4	108	2	36	116 5/8
1922	121 1/4	114	2	38	122 5/8
2022	127 1/4	120	2	40	128 5/8
2222	139 1/4	132	2	44	140 5/8
2422	151 1/4	144	2	48	152 5/8
2622	163 1/4	156	2	52	164 5/8
2822	175 1/4	168	3	42	176 5/8
3022	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES

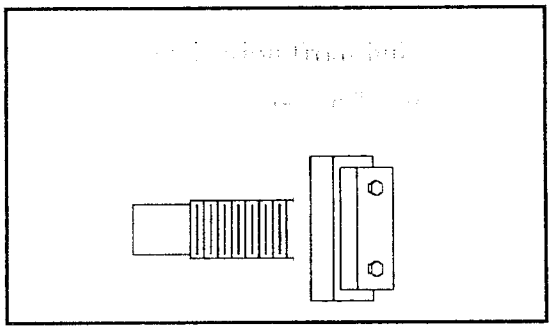
MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

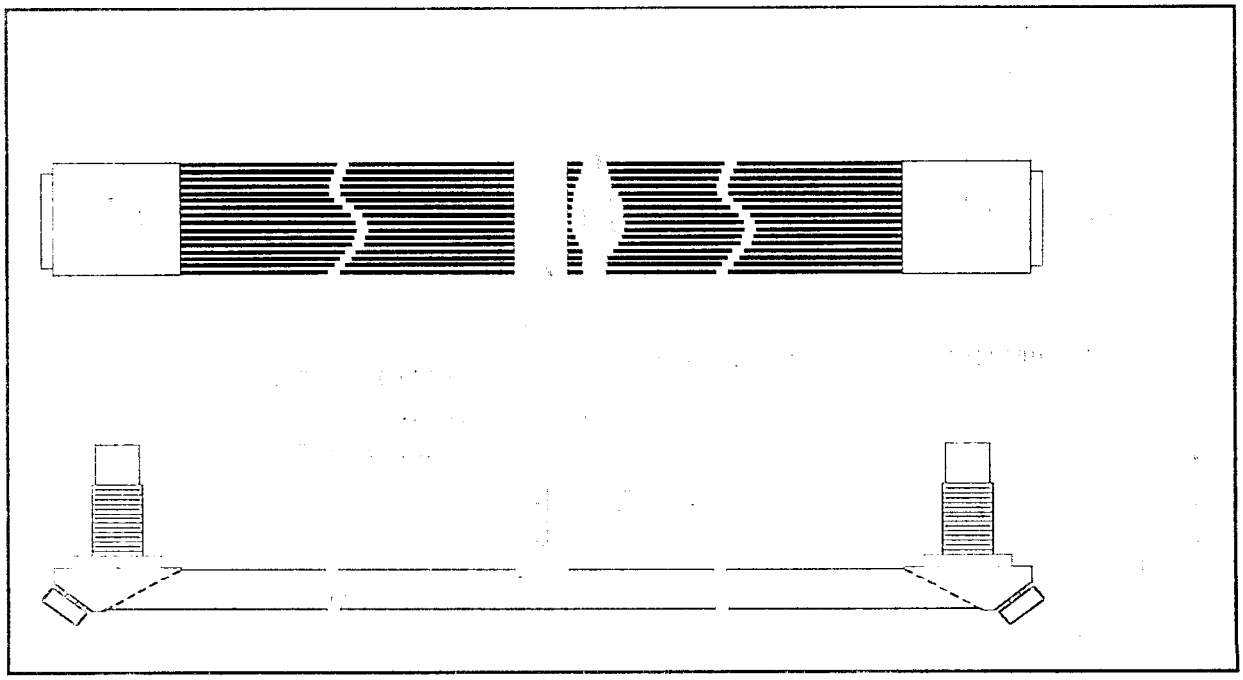
OVERALL LENGTH + 3 INCHES

OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.





Duraweld® Keel Cooler

0024 SERIES
SINGLE PASS

MODEL	A	B	C	D	E
0424	31 1/4	24	- -	- - -	32 5/8
0524	37 1/4	30	- -	- - -	38 5/8
0624	43 1/4	36	- -	- - -	44 5/8
0724	49 1/4	42	- -	- - -	50 5/8
0824	55 1/4	48	- -	- - -	56 5/8
0924	61 1/4	54	- -	- - -	62 5/8
1024	67 1/4	60	- -	- - -	68 5/8
1124	73 1/4	66	1	33	74 5/8
1224	79 1/4	72	1	36	80 5/8
1324	85 1/4	78	1	39	86 5/8
1424	91 1/4	84	1	42	92 5/8
1524	97 1/4	90	1	45	98 5/8
1624	103 1/4	96	2	32	104 5/8
1724	109 1/4	102	2	34	110 5/8
1824	115 1/4	108	2	36	116 5/8
1924	121 1/4	114	2	38	122 5/8
2024	127 1/4	120	2	40	128 5/8
2224	139 1/4	132	2	44	140 5/8
2424	151 1/4	144	2	48	152 5/8
2624	163 1/4	156	2	52	164 5/8
2824	175 1/4	168	3	42	176 5/8
3024	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES.

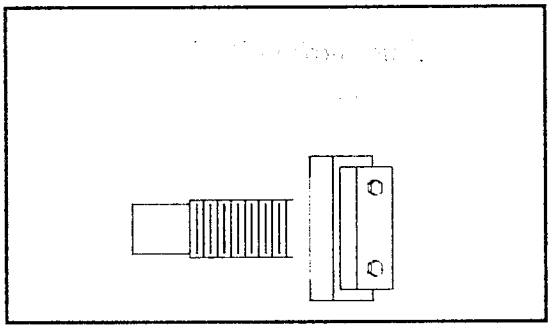
MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

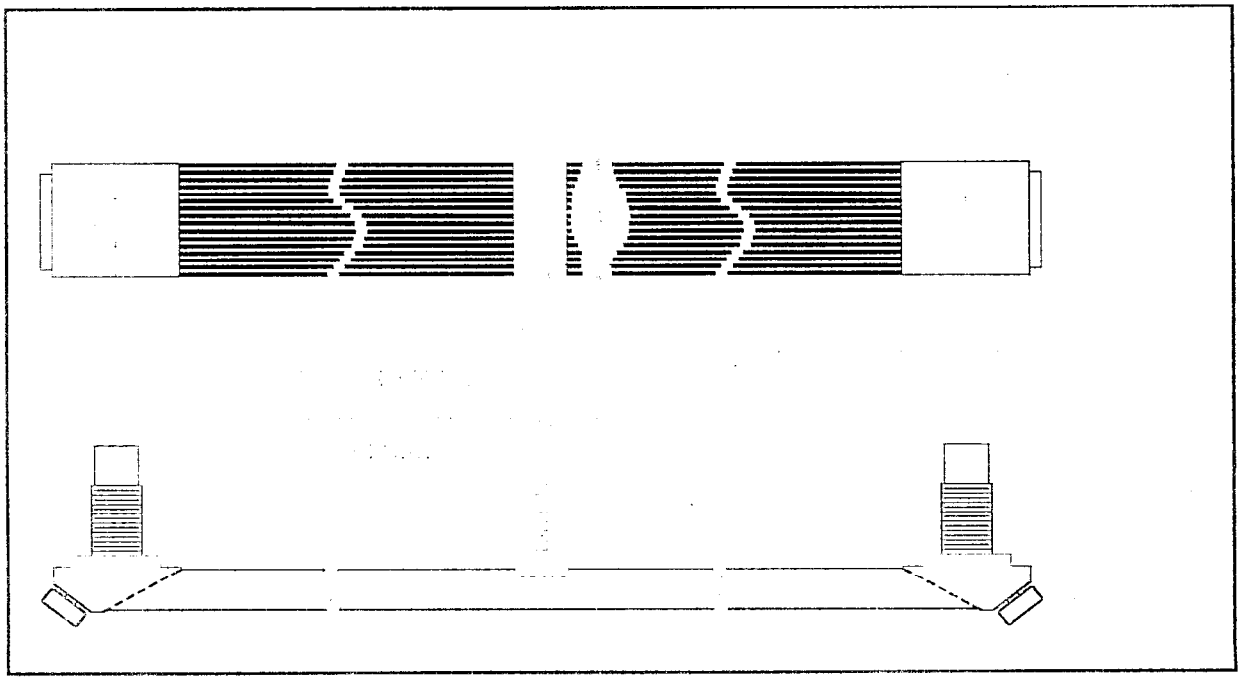
OVERALL LENGTH + 3 INCHES

OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.





Duraweld® Keel Cooler

0008-2 SERIES
TWO PASS

MODEL	A	B	C	D	E
0408-2	31 1/4	24	--	---	32 5/8
0508-2	37 1/4	30	--	---	38 5/8
0608-2	43 1/4	36	--	---	44 5/8
0708-2	49 1/4	42	--	---	50 5/8
0808-2	55 1/4	48	--	---	56 5/8
0908-2	61 1/4	54	--	---	62 5/8
1008-2	67 1/4	60	--	---	68 5/8
1108-2	73 1/4	66	1	33	74 5/8
1208-2	79 1/4	72	1	36	80 5/8
1308-2	85 1/4	78	1	39	86 5/8
1408-2	91 1/4	84	1	42	92 5/8
1508-2	97 1/4	90	2	30	98 5/8
1608-2	103 1/4	96	2	32	104 5/8
1708-2	109 1/4	102	2	34	110 5/8
1808-2	115 1/4	108	2	36	116 5/8
1908-2	121 1/4	114	2	38	122 5/8
2008-2	127 1/4	120	2	40	128 5/8
2208-2	139 1/4	132	2	44	140 5/8
2408-2	151 1/4	144	2	48	152 5/8
2608-2	163 1/4	156	2	52	164 5/8
2808-2	175 1/4	168	3	42	176 5/8
3008-2	187 1/4	180	3	45	188 5/8

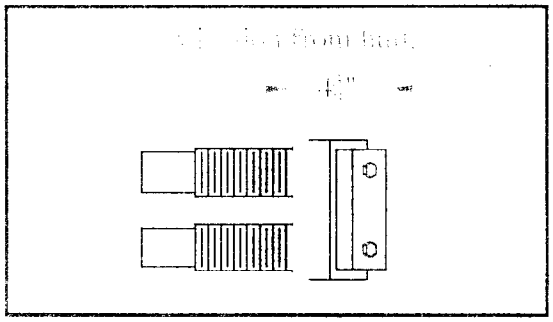
ALL DIMENSIONS ARE IN INCHES.

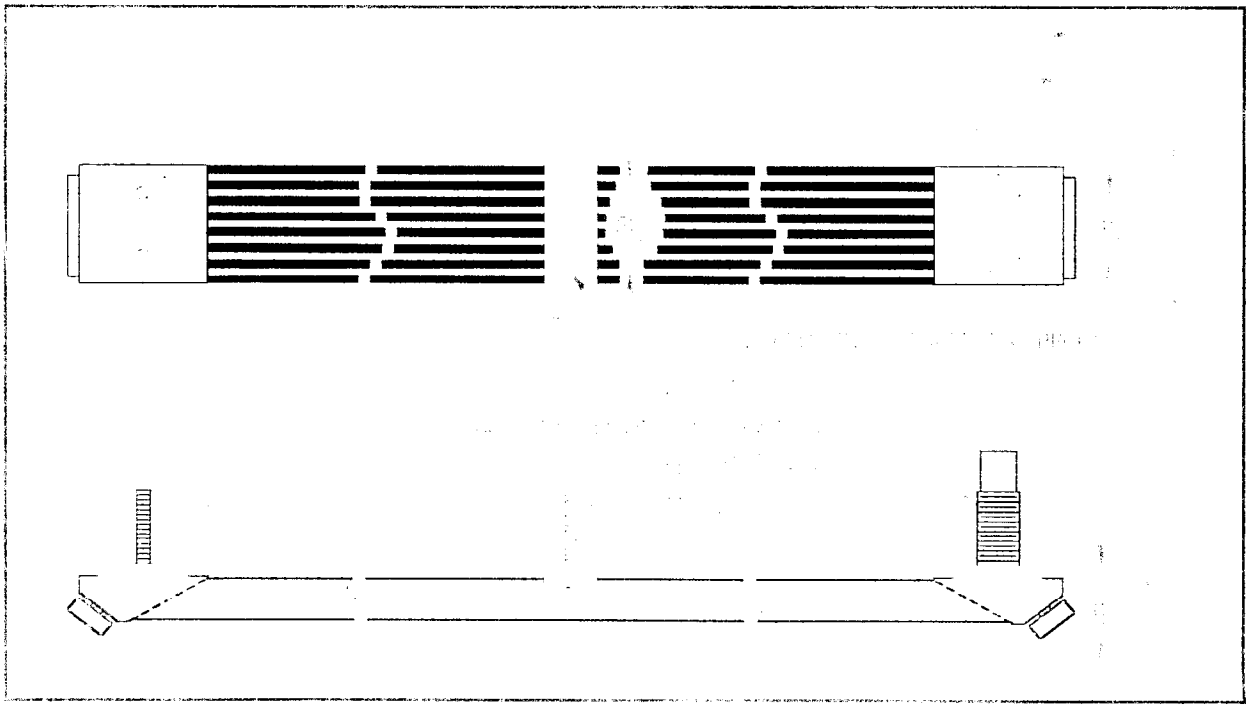
MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES
OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.





Duraweld® Keel Cooler

0010-2 SERIES
TWO PASS

MODEL	A	B	C	D	E
0410-2	31 1/4	24	- -	- - -	32 5/8
0510-2	37 1/4	30	- -	- - -	38 5/8
0610-2	43 1/4	36	- -	- - -	44 5/8
0710-2	49 1/4	42	- -	- - -	50 5/8
0810-2	55 1/4	48	- -	- - -	56 5/8
0910-2	61 1/4	54	- -	- - -	62 5/8
1010-2	67 1/4	60	- -	- - -	68 5/8
1110-2	73 1/4	66	1	33	74 5/8
1210-2	79 1/4	72	1	36	80 5/8
1310-2	85 1/4	78	1	39	86 5/8
1410-2	91 1/4	84	1	42	92 5/8
1510-2	97 1/4	90	2	30	98 5/8
1610-2	103 1/4	96	2	32	104 5/8
1710-2	109 1/4	102	2	34	110 5/8
1810-2	115 1/4	108	2	36	116 5/8
1910-2	121 1/4	114	2	38	122 5/8
2010-2	127 1/4	120	2	40	128 5/8
2210-2	139 1/4	132	2	44	140 5/8
2410-2	151 1/4	144	2	48	152 5/8
2610-2	163 1/4	156	2	52	164 5/8
2810-2	175 1/4	168	3	42	176 5/8
3010-2	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES.

MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES
OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

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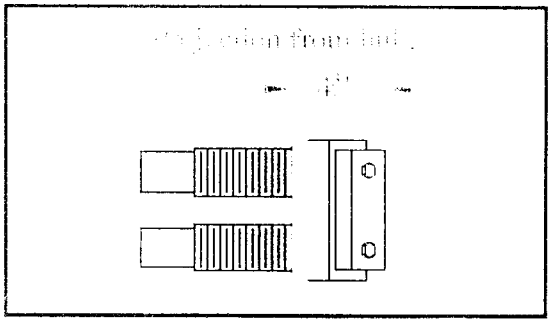

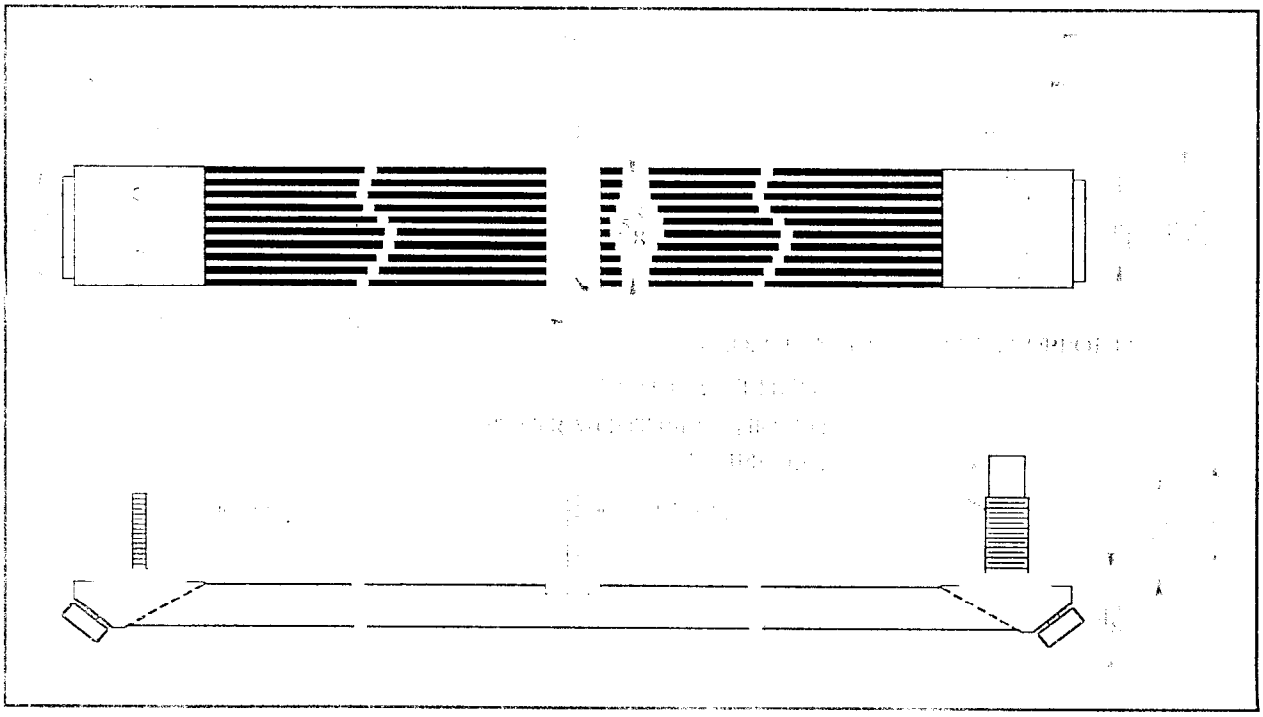

Duraweld® Keel Cooler

0012-2 SERIES
TWO PASS

MODEL	A	B	C	D	E
0412-2	31 1/4	24	- -	- - -	32 5/8
0512-2	37 1/4	30	- -	- - -	38 5/8
0612-2	43 1/4	36	- -	- - -	44 5/8
0712-2	49 1/4	42	- -	- - -	50 5/8
0812-2	55 1/4	48	- -	- - -	56 5/8
0912-2	61 1/4	54	- -	- - -	62 5/8
1012-2	67 1/4	60	- -	- - -	68 5/8
1112-2	73 1/4	66	1	33	74 5/8
1212-2	79 1/4	72	1	36	80 5/8
1312-2	85 1/4	78	1	39	86 5/8
1412-2	91 1/4	84	1	42	92 5/8
1512-2	97 1/4	90	2	30	98 5/8
1612-2	103 1/4	96	2	32	104 5/8
1712-2	109 1/4	102	2	34	110 5/8
1812-2	115 1/4	108	2	36	116 5/8
1912-2	121 1/4	114	2	38	122 5/8
2012-2	127 1/4	120	2	40	128 5/8
2212-2	139 1/4	132	2	44	140 5/8
2412-2	151 1/4	144	2	48	152 5/8
2612-2	163 1/4	156	2	52	164 5/8
2812-2	175 1/4	168	3	42	176 5/8
3012-2	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES.

MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES
OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

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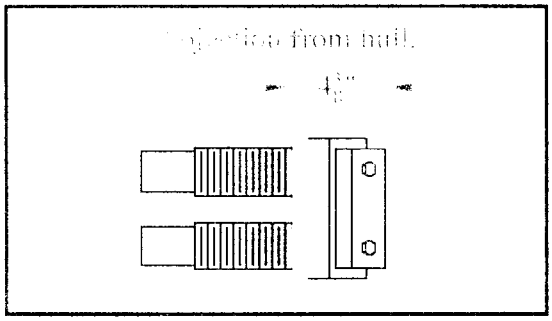

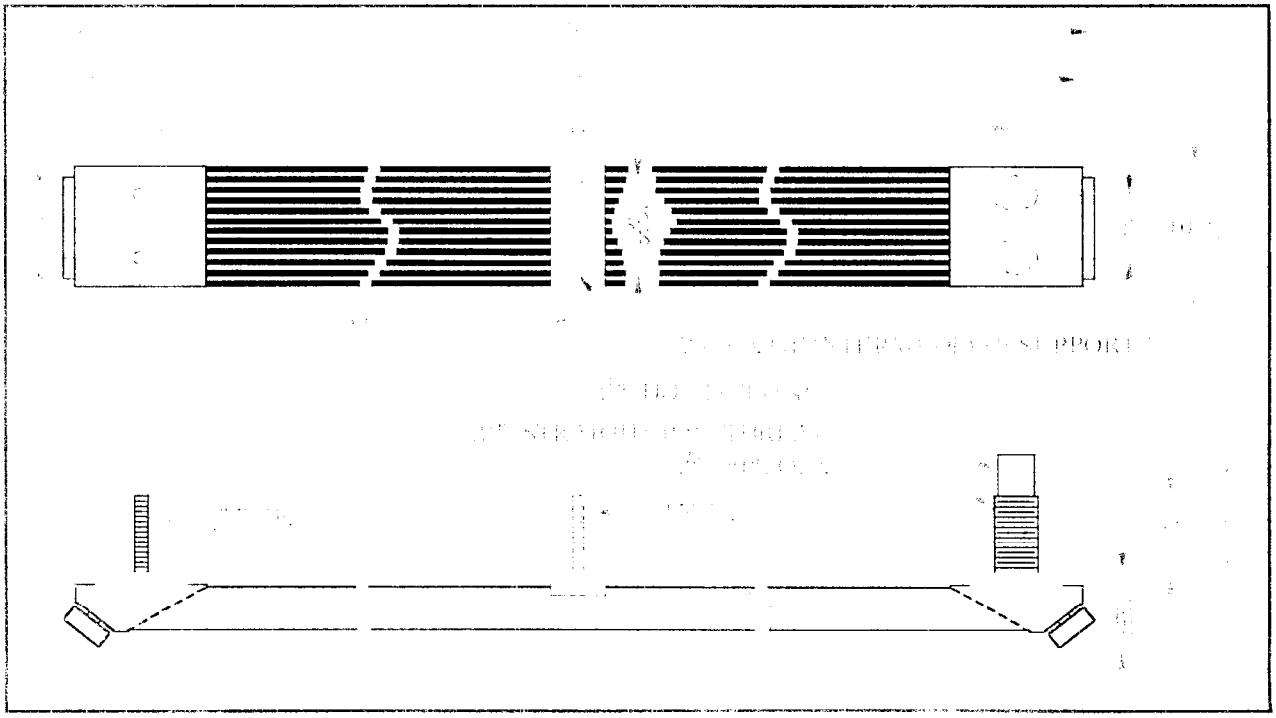

Duraweld® Keel Cooler

0014-2 SERIES
TWO PASS

MODEL	A	B	C	D	E
0414-2	31 1/4	24	--	---	32 5/8
0514-2	37 1/4	30	--	---	38 5/8
0614-2	43 1/4	36	--	---	44 5/8
0714-2	49 1/4	42	--	---	50 5/8
0814-2	55 1/4	48	--	---	56 5/8
0914-2	61 1/4	54	--	---	62 5/8
1014-2	67 1/4	60	--	---	68 5/8
1114-2	73 1/4	66	1	33	74 5/8
1214-2	79 1/4	72	1	36	80 5/8
1314-2	85 1/4	78	1	39	86 5/8
1414-2	91 1/4	84	1	42	92 5/8
1514-2	97 1/4	90	1	45	98 5/8
1614-2	103 1/4	96	2	32	104 5/8
1714-2	109 1/4	102	2	34	110 5/8
1814-2	115 1/4	108	2	36	116 5/8
1914-2	121 1/4	114	2	38	122 5/8
2014-2	127 1/4	120	2	40	128 5/8
2214-2	139 1/4	132	2	44	140 5/8
2414-2	151 1/4	144	2	48	152 5/8
2614-2	163 1/4	156	2	52	164 5/8
2814-2	175 1/4	168	3	42	176 5/8
3014-2	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES

MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES

OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

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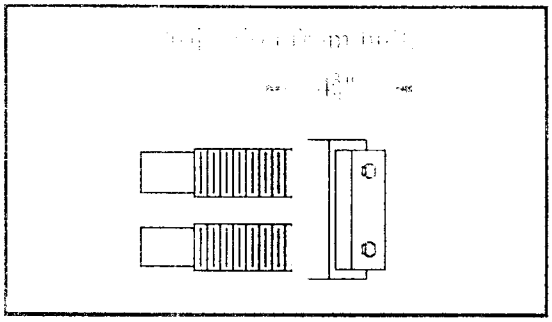

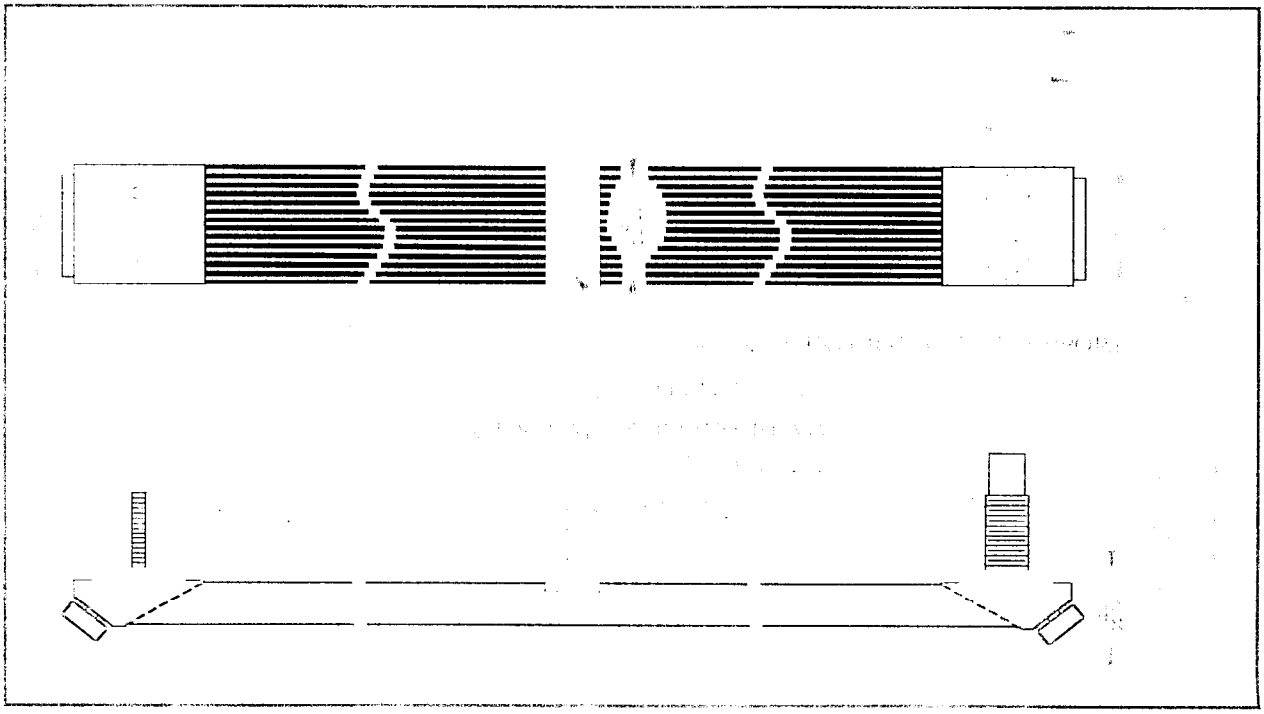

Duraweld® Keel Cooler

0016-2 SERIES
TWO PASS

MODEL	A	B	C	D	E
0416-2	31 1/4	24	- -	- - -	32 5/8
0516-2	37 1/4	30	- -	- - -	38 5/8
0616-2	43 1/4	36	- -	- - -	44 5/8
0716-2	49 1/4	42	- -	- - -	50 5/8
0816-2	55 1/4	48	- -	- - -	56 5/8
0916-2	61 1/4	54	- -	- - -	62 5/8
1016-2	67 1/4	60	- -	- - -	68 5/8
1116-2	73 1/4	66	1	33	74 5/8
1216-2	79 1/4	72	1	36	80 5/8
1316-2	85 1/4	78	1	39	86 5/8
1416-2	91 1/4	84	1	42	92 5/8
1516-2	97 1/4	90	1	45	98 5/8
1616-2	103 1/4	96	2	32	104 5/8
1716-2	109 1/4	102	2	34	110 5/8
1816-2	115 1/4	108	2	36	116 5/8
1916-2	121 1/4	114	2	38	122 5/8
2016-2	127 1/4	120	2	40	128 5/8
2216-2	139 1/4	132	2	44	140 5/8
2416-2	151 1/4	144	2	48	152 5/8
2616-2	163 1/4	156	2	52	164 5/8
2816-2	175 1/4	168	3	42	176 5/8
3016-2	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES.

MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES
OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

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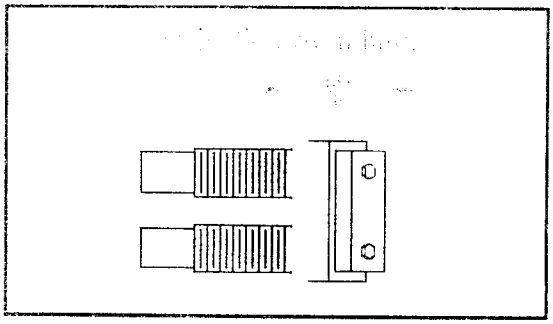

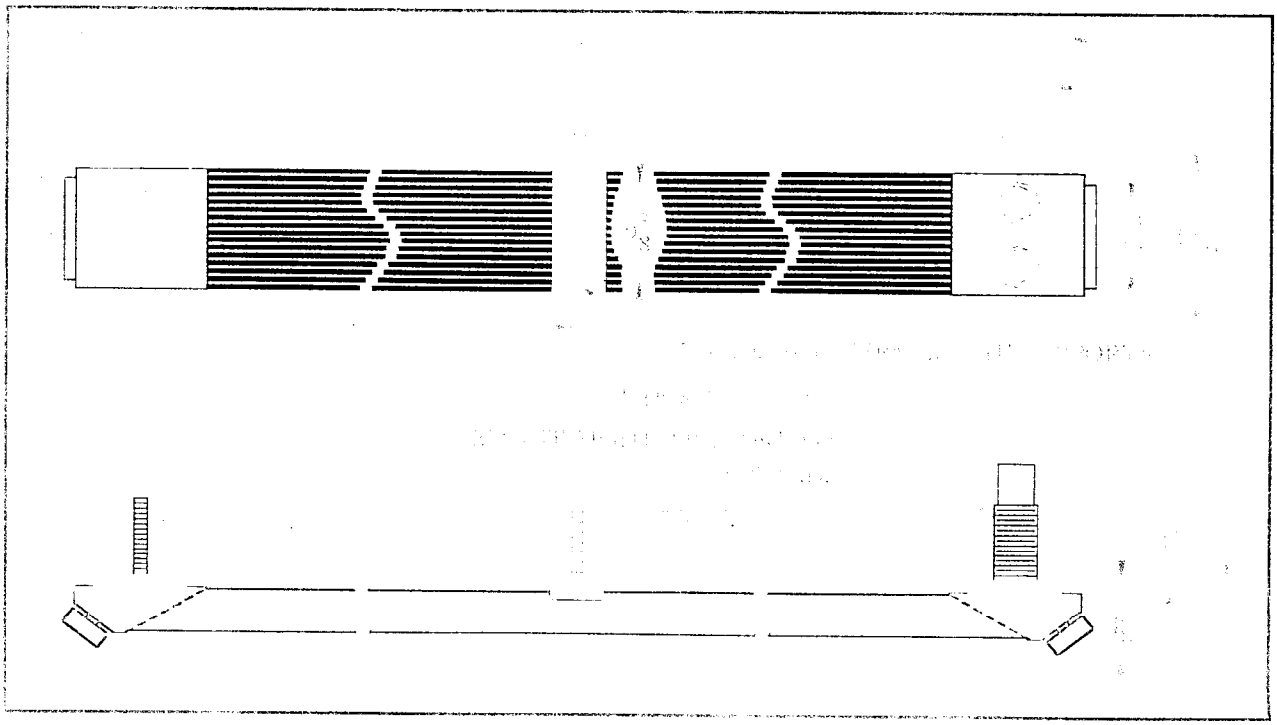

Duraweld® Keel Cooler

0018-2 SERIES
TWO PASS

MODEL	A	B	C	D	E
0418-2	31 1/4	24	- -	- - -	32 5/8
0518-2	37 1/4	30	- -	- - -	38 5/8
0618-2	43 1/4	36	- -	- - -	44 5/8
0718-2	49 1/4	42	- -	- - -	50 5/8
0818-2	55 1/4	48	- -	- - -	56 5/8
0918-2	61 1/4	54	- -	- - -	62 5/8
1018-2	67 1/4	60	- -	- - -	68 5/8
1118-2	73 1/4	66	1	33	74 5/8
1218-2	79 1/4	72	1	36	80 5/8
1318-2	85 1/4	78	1	39	86 5/8
1418-2	91 1/4	84	1	42	92 5/8
1518-2	97 1/4	90	1	45	98 5/8
1618-2	103 1/4	96	2	32	104 5/8
1718-2	109 1/4	102	2	34	110 5/8
1818-2	115 1/4	108	2	36	116 5/8
1918-2	121 1/4	114	2	38	122 5/8
2018-2	127 1/4	120	2	40	128 5/8
2218-2	139 1/4	132	2	44	140 5/8
2418-2	151 1/4	144	2	48	152 5/8
2618-2	163 1/4	156	2	52	164 5/8
2818-2	175 1/4	168	3	42	176 5/8
3018-2	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES.

MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES

OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

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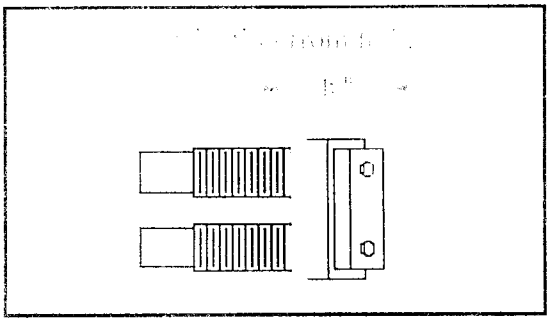
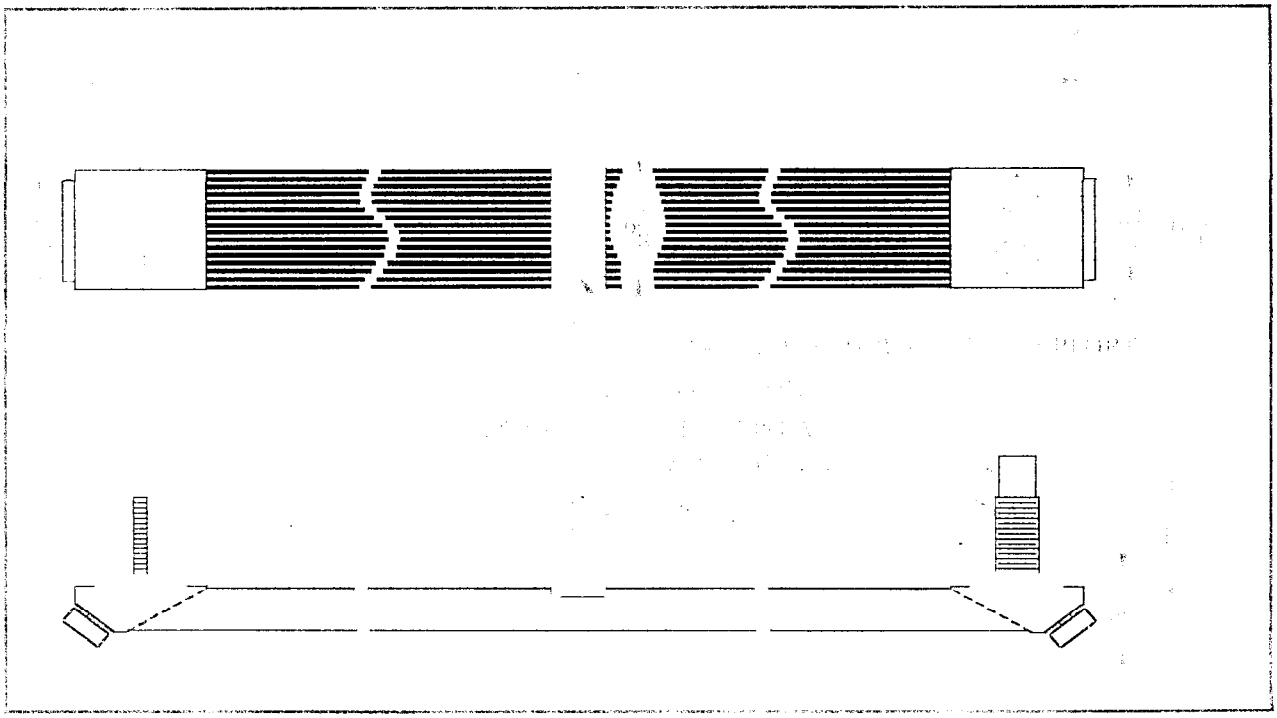




Duraweld® Keel Cooler

0020-2 SERIES
TWO PASS

MODEL	A	B	C	D	E
0420-2	31 1/4	24	--	---	32 5/8
0520-2	37 1/4	30	--	---	38 5/8
0620-2	43 1/4	36	--	---	44 5/8
0720-2	49 1/4	42	--	---	50 5/8
0820-2	55 1/4	48	--	---	56 5/8
0920-2	61 1/4	54	--	---	62 5/8
1020-2	67 1/4	60	--	---	68 5/8
1120-2	73 1/4	66	1	33	74 5/8
1220-2	79 1/4	72	1	36	80 5/8
1320-2	85 1/4	78	1	39	86 5/8
1420-2	91 1/4	84	1	42	92 5/8
1520-2	97 1/4	90	1	45	98 5/8
1620-2	103 1/4	96	2	32	104 5/8
1720-2	109 1/4	102	2	34	110 5/8
1820-2	115 1/4	108	2	36	116 5/8
1920-2	121 1/4	114	2	38	122 5/8
2020-2	127 1/4	120	2	40	128 5/8
2220-2	139 1/4	132	2	44	140 5/8
2420-2	151 1/4	144	2	48	152 5/8
2620-2	163 1/4	156	2	52	164 5/8
2820-2	175 1/4	168	3	42	176 5/8
3020-2	187 1/4	180	3	45	188 5/8

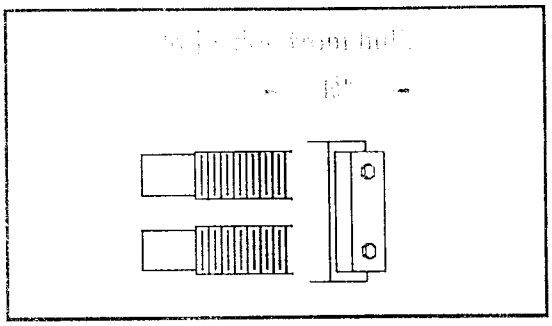
ALL DIMENSIONS ARE IN INCHES.

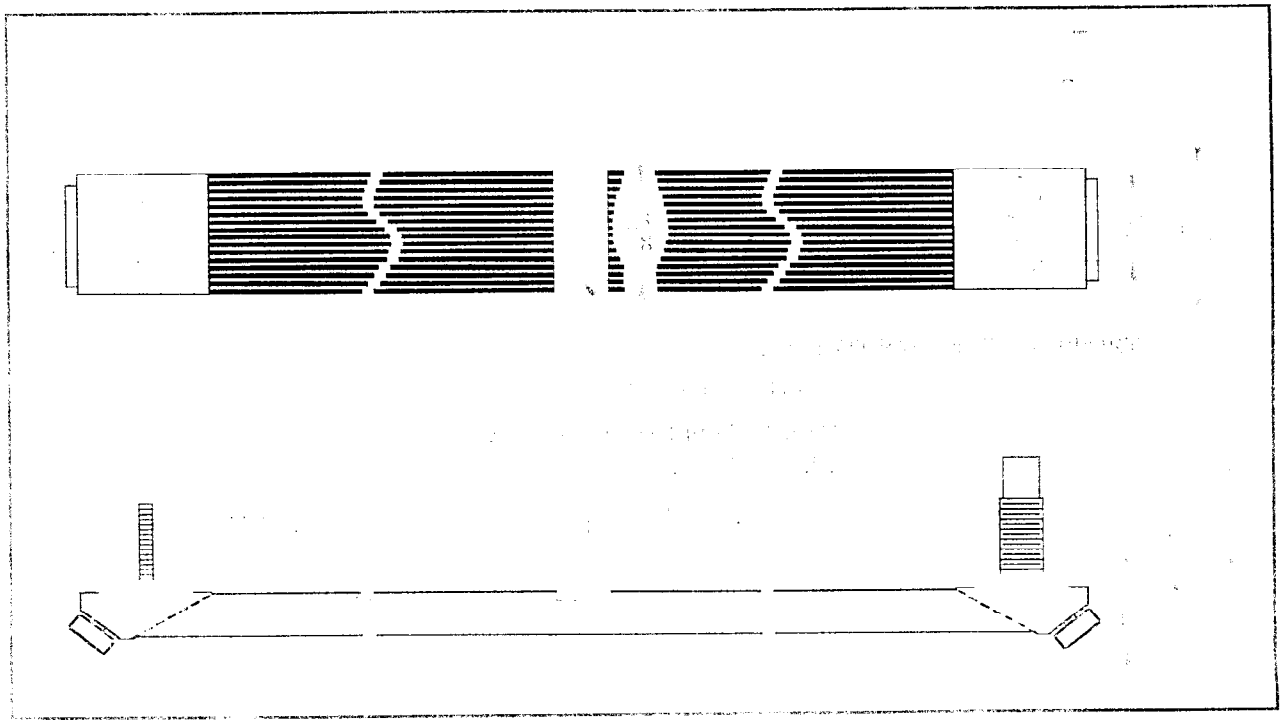
MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES
OVERALL WIDTH + 3 INCHES

HULL RECESS DIMENSIONS ARE MINIMUM RECESS DIMENSIONS AND DO NOT TAKE INTO CONSIDERATION THE USE OF LARGE ANODE BLOCKS BEING IN THE RECESS.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.





Duraweld® Keel Cooler

0022-2 SERIES
TWO PASS

MODEL	A	B	C	D	E
0422-2	31 1/4	24	- -	- - -	32 5/8
0522-2	37 1/4	30	- -	- - -	38 5/8
0622-2	43 1/4	36	- -	- - -	44 5/8
0722-2	49 1/4	42	- -	- - -	50 5/8
0822-2	55 1/4	48	- -	- - -	56 5/8
0922-2	61 1/4	54	- -	- - -	62 5/8
1022-2	67 1/4	60	- -	- - -	68 5/8
1122-2	73 1/4	66	1	33	74 5/8
1222-2	79 1/4	72	1	36	80 5/8
1322-2	85 1/4	78	1	39	86 5/8
1422-2	91 1/4	84	1	42	92 5/8
1522-2	97 1/4	90	1	45	98 5/8
1622-2	103 1/4	96	2	32	104 5/8
1722-2	109 1/4	102	2	34	110 5/8
1822-2	115 1/4	108	2	36	116 5/8
1922-2	121 1/4	114	2	38	122 5/8
2022-2	127 1/4	120	2	40	128 5/8
2222-2	139 1/4	132	2	44	140 5/8
2422-2	151 1/4	144	2	48	152 5/8
2622-2	163 1/4	156	2	52	164 5/8
2822-2	175 1/4	168	3	42	176 5/8
3022-2	187 1/4	180	3	45	188 5/8

ALL DIMENSIONS ARE IN INCHES

MINIMUM HULL RECESS DIMENSIONS FOR DURAWELD KEEL COOLERS:

OVERALL LENGTH + 3 INCHES

OVERALL WIDTH + 3 INCHES

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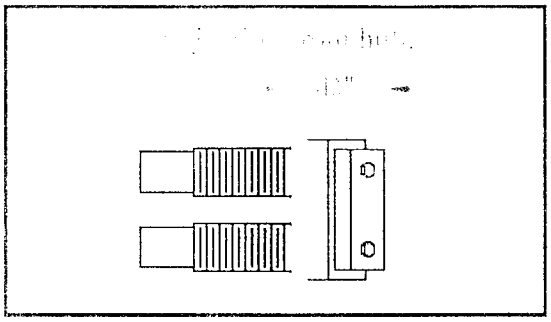

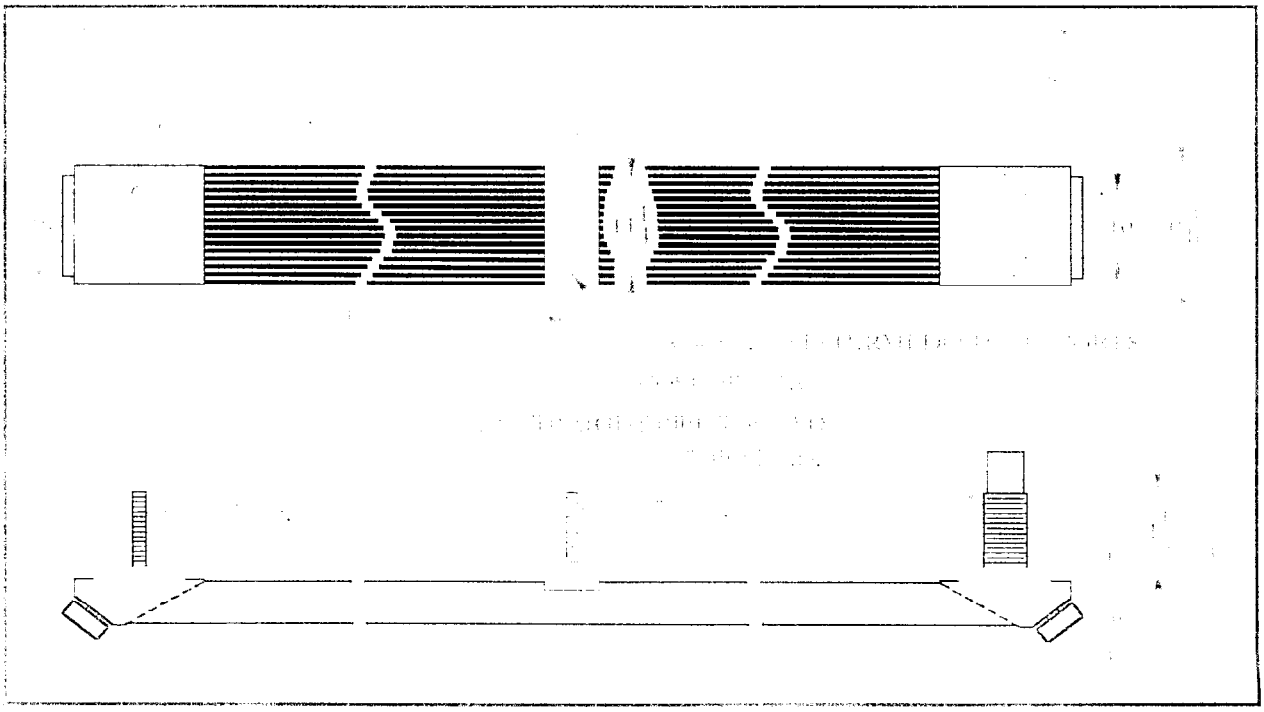

Duraweld® Keel Cooler

0024-2 SERIES
TWO PASS

MODEL	A	B	C	D	E
0424-2	31 1/4	24	- -	- - -	32 5/8
0524-2	37 1/4	30	- -	- - -	38 5/8
0624-2	43 1/4	36	- -	- - -	44 5/8
0724-2	49 1/4	42	- -	- - -	50 5/8
0824-2	55 1/4	48	- -	- - -	56 5/8
0924-2	61 1/4	54	- -	- - -	62 5/8
1024-2	67 1/4	60	- -	- - -	68 5/8
1124-2	73 1/4	66	1	33	74 5/8
1224-2	79 1/4	72	1	36	80 5/8
1324-2	85 1/4	78	1	39	86 5/8
1424-2	91 1/4	84	1	42	92 5/8
1524-2	97 1/4	90	1	45	98 5/8
1624-2	103 1/4	96	2	32	104 5/8
1724-2	109 1/4	102	2	34	110 5/8
1824-2	115 1/4	108	2	36	116 5/8
1924-2	121 1/4	114	2	38	122 5/8
2024-2	127 1/4	120	2	40	128 5/8
2224-2	139 1/4	132	2	44	140 5/8
2424-2	151 1/4	144	2	48	152 5/8
2624-2	163 1/4	156	2	52	164 5/8
2824-2	175 1/4	168	3	42	176 5/8
3024-2	187 1/4	180	3	45	188 5/8

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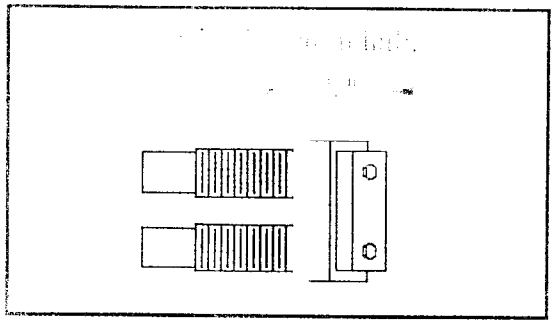
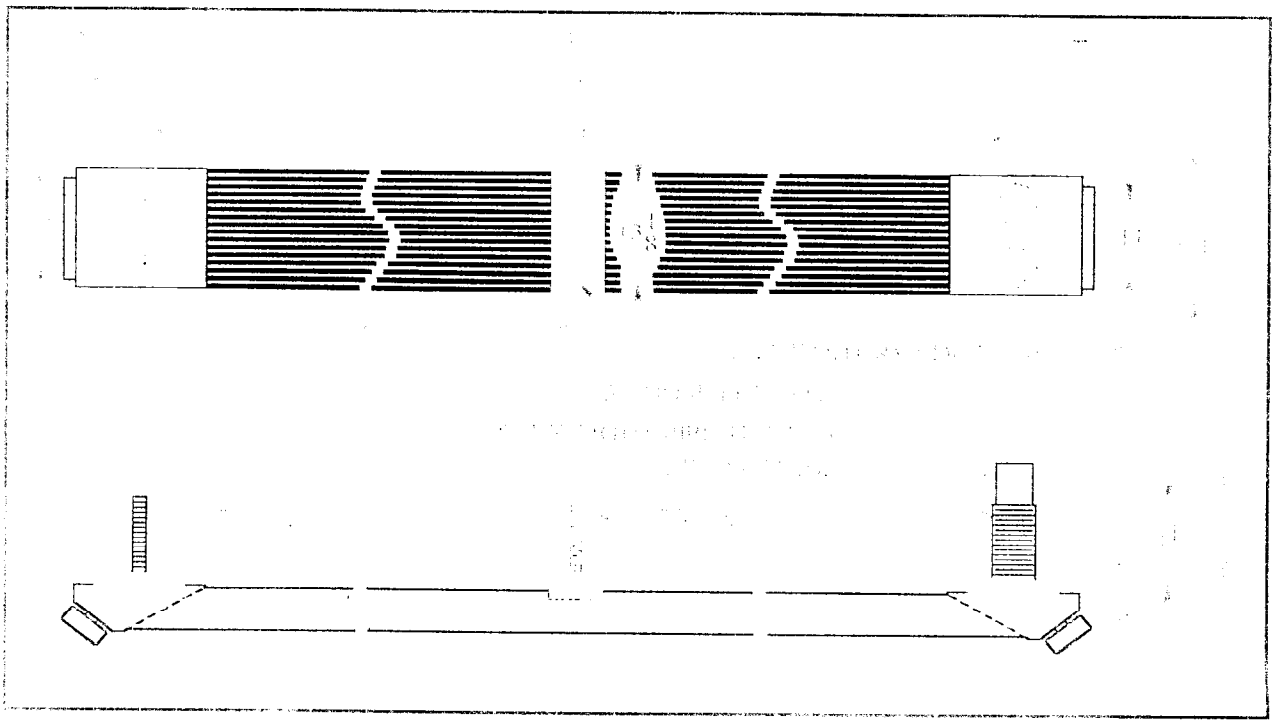




Attorney Docket DX-3 (#90545)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE TRADEMARK TRIAL AND APPEAL BOARD

In the Matter of:

Application Serial No. 75/701,707
Mark: Drawing of a Marine Heat Exchanger
Published in the Official Gazette at Page TM 400 on May 9, 2000

DURAMAX MARINE, LLC	)	
	)	
Opposer,	)	
	)	
v.	)	Opposition No. 91119899
	)	
R.W. FERNSTRUM & COMPANY,	)	
	)	
Applicant	)	

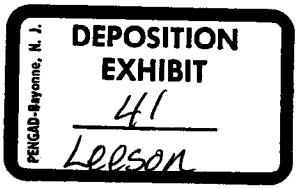
Commissioner for Trademarks
2900 Crystal Drive
Arlington, VA 22202-3513

OPPOSER'S NOTICE OF TESTIMONY DEPOSITION

Please take notice that, pursuant to Trademark Rule 2.123(c), Opposer Duramax Marine, LLC, by its attorney, will take the testimony deposition upon oral examination of its Senior Engineer, Mr. Jeffrey S. Leeson of 4488 Mackall Rd., South Euclid, Ohio 44121, on April 22, 2004 at 10:00 a.m. at the office of D. Peter Hochberg Co., L.P.A., 1940 East 6th Street, 6th Floor, Cleveland, Ohio, 44114.

The deposition shall take place before a certified court reporter and shall continue until completed. The deposition shall seek background information about the deponent, the deponent's identification of documents, the deponent's testimony regarding the proposed trademark of Application Serial No. 75/701,707 and the proposed mark's relationship to keel coolers, the deponent's testimony on the prosecution of Application Serial No. 75/701,707, and the deponent's testimony on the keel cooler industry.

You are invited to attend and cross-examine.



Respectfully submitted,

Date: April 15, 2004

By: _____
D. Peter Hochberg
Counsel for Opposer

D. Peter Hochberg Co., L.P.A.
The Baker Building – 6th Floor
1940 East Sixth Street
Cleveland, Ohio 44114
(216) 771-3800

CERTIFICATE OF SERVICE

The undersigned hereby certifies that the OPPOSER'S NOTICE OF TESTIMONY DEPOSITION is being served by facsimile (1-202-659-1559) with confirmation by regular U.S. Mail, postage prepaid, to counsel for Applicant, Samuel D. Littlepage, Dickinson Wright PLLC, 1901 L Street, N.W. – Suite 800, Washington, D.C. 20036-3506, on the date shown below.

Date: April 15, 2004

Sean Mellino