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BIBLIOGRAPHY OF U.S. PATENTS ON AUGMENTATION OF CONVECTIVE HEAT AND MASS TRANSFER-II

Bibliographic Report

By
R. L. Webb
A. E. Bergles
G. H. Junkhan

December 1983

Work Performed Under Contract No. FG07-81ID12222

Iowa State University
Ames, Iowa

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ENGINEERING RESEARCH

Bibliographic Report

BIBLIOGRAPHY OF U.S. PATENTS ON AUGMENTATION OF CONVECTIVE HEAT AND MASS TRANSFER-II

R. L. Webb, A. E. Bergles,
and G. H. Junkhan

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TABLE OF CONTENTS

	Page
ABSTRACT	iv
INTRODUCTION	1
AUGMENTATION TECHNIQUES	3
Passive Techniques	3
Active Techniques	4
CLASSIFICATION OF PATENTS	7
CITATION COLLECTION	9
CONCLUDING REMARKS	13
ACKNOWLEDGMENTS	13
REFERENCES	15
TABLES	17
LIST BY PATENT NUMBER	29
LIST BY FIRST INVENTOR	87
LIST BY TECHNIQUE-MODE	143

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ABSTRACT

Patents are an important source of information on the potential commercialization of augmented heat transfer technology. This report presents a bibliography of U.S. patents pertinent to that technology. The total number of patents cited is 454. They are presented in three separate lists: by patent number, alphabetically by first inventor, and by augmentation technique (with secondary arrangement according to mode of heat transfer).

INTRODUCTION

This report describes U.S. patent literature on heat transfer augmentation or enhancement. Basically, heat transfer augmentation techniques permit the design of more efficient, more compact, or less costly heat exchange equipment. Many techniques have made the transition from the laboratory to full-scale industrial equipment. This transition is documented by three types of technical literature: technical papers and reports, patents, and manufacturers' information. The present report is the second edition of a bibliography of U.S. Patent literature. The first report, published in 1980 [1], contained references to 321 patents. The present report contains all of the information in that report plus 133 new U.S. patents. Patents with issue dates up to June 30, 1983 are included.

This U.S. patent report is complementary to a bibliographic report on journal and conference papers [2]. That report contains 3,045 references.

The present report classifies the patents in three ways. The first two are by patent number and by name of the first named inventor. The third compilation is similar to that used in Reference 2, in that the patents are classified by augmentation technique, mode of heat transfer, and geometry. The modes include single-phase, boiling, and condensing heat transfer. Mass transfer is included for completeness as well as its relevance, by analogy, to augmentation of single-phase flows. The techniques are divided into two basic categories: passive and active techniques. Passive techniques employ special surface

geometries or fluid additives and do not require external power for their effect. The active techniques require external power to accomplish the augmentation. Brief descriptions of the two technique classifications follow.

AUGMENTATION TECHNIQUES

Passive Techniques

Treated surfaces involve fine-scale alteration of the surface finish or coatings (continuous or discontinuous), and are normally used for boiling and condensing. When used for single-phase forced convection, the roughness size is usually larger.

Rough surfaces are produced in many configurations ranging from random sand-grain-type roughness to discrete protuberances. For purposes of this report, the roughness is integral to the heat transfer surface. The configuration is generally chosen to promote turbulence rather than to increase the heat transfer surface area. Application of rough surfaces is usually directed toward single-phase flow.

Attached promoters include types of discrete roughness that are not integral to the heat transfer surface. A good example is the wire coil insert used in circular tubes.

Extended surfaces are routinely employed in many heat exchangers to provide increased surface area. Current enhancement efforts are directed toward new types of extended surfaces, such as integral inner-fin tubing, and improvement of heat transfer coefficients on extended surfaces by shaping or perforating the surfaces.

Displaced enhancement devices are inserted into the flow channel so as to indirectly improve energy transport at the heated surface. They are used with forced flow.

Formed channels are typified by corrugated plates used in plate-fin heat exchangers. The surface distortion is much greater than that typical

of roughness. The surface deformation causes mixing by secondary flows. Surface area increase usually is not a significant factor, although three-dimensionally deformed tubes, also included in this classification, can provide a surface area increase of up to 30%. Formed channels provide enhancement to the fluid flowing on each side of the channel.

Swirl flow devices include a number of geometrical arrangements or tube inserts for forced flow that create rotating and/or secondary flow: inlet vortex generators, twisted-tape inserts, and axial core inserts with a screw-type winding.

Surface tension devices involve wicks or grooved surfaces to transport liquid in boiling and condensing systems.

Additives for liquids include solid particles or gas bubbles in single-phase flows and liquid trace additives for boiling systems.

Additives for gases are liquid droplets or solid particles. Solid additives may be either dilute phase (gas-solid suspensions) or dense phase (packed tubes and fluidized beds).

Active Techniques

Mechanical aids involve stirring the fluid by mechanical means or rotating the surface. Surface "scraping," widely used for viscous liquids in the chemical process industry, can be applied to duct flow of gases. Equipment with rotating heat exchanger ducts is found in commercial practice.

Surface vibration at either low or high frequency has been used primarily to improve single-phase heat transfer.

Fluid vibration is the more practical type of vibration enhancement due to the mass of most heat exchangers. The vibrations range from pulsations of about 1 Hz to ultrasound. Single-phase fluids are of primary concern.

Electrostatic fields (d.c. or a.c.) are applied in many different ways to dielectric fluids. Generally speaking, electrostatic fields can be directed to cause greater bulk mixing of fluid in the vicinity of the heat transfer surface.

Injection is utilized by supplying gas through a porous heat transfer surface to a flow of liquid, or by injecting the same liquid upstream of the heat transfer section. The injected gas augments single-phase flow. Surface degassing of liquids may produce similar effects.

Suction involves vapor removal, in nucleate or film boiling, or fluid withdrawal, in single-phase flow, through a porous heated surface.

Two or more of the above techniques may be used simultaneously to produce an enhancement that is larger than any one of the techniques operating separately. This is termed compound enhancement.

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CLASSIFICATION OF PATENTS

The patents cited in this report are organized according to the following coding system.

Technique

01 Treated surfaces

02 Rough surfaces

03 Attached promoters

04 Extended surfaces

05 Displaced enhancement devices

06 Formed channels

07 Swirl flow devices

08 Surface tension devices

09 Additives for liquids

10 Additives for gases

11 Mechanical aids

12 Surface vibration

13 Fluid vibration

14 Electrostatic fields

15 Injection or suction

16 Compound enhancement

Mode of Transfer

1 Single-phase natural convection

2 Single-phase forced convection

3 Pool boiling

4 Flow boiling

5 Condensation

6 Mass transfer

Geometry Classification

A Inside tubes

B Outside tubes--gases

C Outside tubes--liquids

D Plate-type heat exchangers

E Fin-type heat exchangers

F Other geometries

For example, a code of 023C indicates a rough surface for pool boiling, with the roughness on the outer surface of a tube. It should be noted that this classification is slightly different from that used in Reference 2.

CITATION COLLECTION

The present compilation contains patents issued through June 1983. The collection was developed over the previous 14 years. An intensive "hands on" search of patents on file at the U.S. Patent Office was performed for the first edition of the report [1].

Because there are more than 10,000 patent subclasses, it was necessary to develop a logical approach to define which subclasses were worthy of search. The patent subclasses selected for search were established by several parallel efforts. First, the U.S. Patent Office Class Definitions, which lists and describes the subclasses within each patent class, was reviewed. Study of this document suggested potentially fruitful areas. Second, a patent law firm was consulted for guidance. The final and most successful method involved an iterative search method. At the beginning of the intensive search, there were approximately 100 patents on file. A "frequency distribution table" that defined the classes/subclasses of those patents was made. The patents themselves also provided some cross-reference information. This worksheet table, along with the previously indicated fruitful areas, identified the initial classes/subclasses to be searched. In addition, current issues of the biweekly Official Patent Gazette, which publishes abstracts of new patents, were monitored during the search period. This publication was the primary source of recent patents for the second edition.

Copies of approximately 900 patents were ordered from the Commissioner of Patents and Trademarks, Washington, D.C. The patents were

then carefully reviewed for relevance and cataloged by the previously described coding system.

Table 1 shows the classes/subclasses from which patents have been obtained. Column 3 shows the number of patents in the final listing associated with each subclass. This frequency of occurrence information may be helpful to those who wish to perform a similar patent search. The titles, taken from the current Manual of Classification, [3], give some idea of the features of each invention. It is noted that some titles are not given. This means that they have been deleted from the Manual of Classification, as part of the continuing effort to refine the classification. Older Manuals that contain the necessary information were not available. The "no class" patents at the end of Table 1 refer to patents which contain no classification information on the patent copy.

The final list in this report contains 486 entries obtained from 454 separate patents. There are 31 patents for which more than one technique-mode is appropriate; one patent actually has three technique-mode entries. Copies of the patents are filed in the Mechanical Engineering Department at Pennsylvania State University and in the Heat Transfer Laboratory at Iowa State University.

A computer program was employed to store and process the bibliographic information. An existing Penn State computer program, "Bibliographic and Grouping System" (BAG) was employed. BAG is designed to handle general bibliographic tasks involving categorization schemes.

A patent entry, typical of those listed in this bibliography file, is given below:

3,587,730 Milton, R. M.	(patent number and inventor)
1971 June 28	(date of patent issue)
165/110	(patent class/subclass)
013C	(technique-mode-geometry classification)
Heat Exchange System with Porous Boiling Layer	(title)

Assignees are also identified (opposite the date of issue) for the patents added subsequent to the first edition of the report. The computer file was used to generate the three output listings contained in this report. These are:

1. Chronological listing by patent number.
2. Alphabetical listing by first listed inventor.
3. Technique-mode-geometry classification listing.

Table 2 shows the distribution of patents within each technique-mode classification. The 32 multiple listings are reflected in this table. Augmentation techniques for single-phase forced convection comprise 60% of the patents listed in the file; 88% of the patents involve the "passive techniques." Virtually all of the "passive techniques" involve special surface geometries.

Figure 1, which shows the number of filed patents issued by year since 1928, indicates that U.S. patent activity relevant to heat transfer augmentation has continued on a high level since 1965. During the five-year period of 1978-1982, more than 20 patents per year were granted.

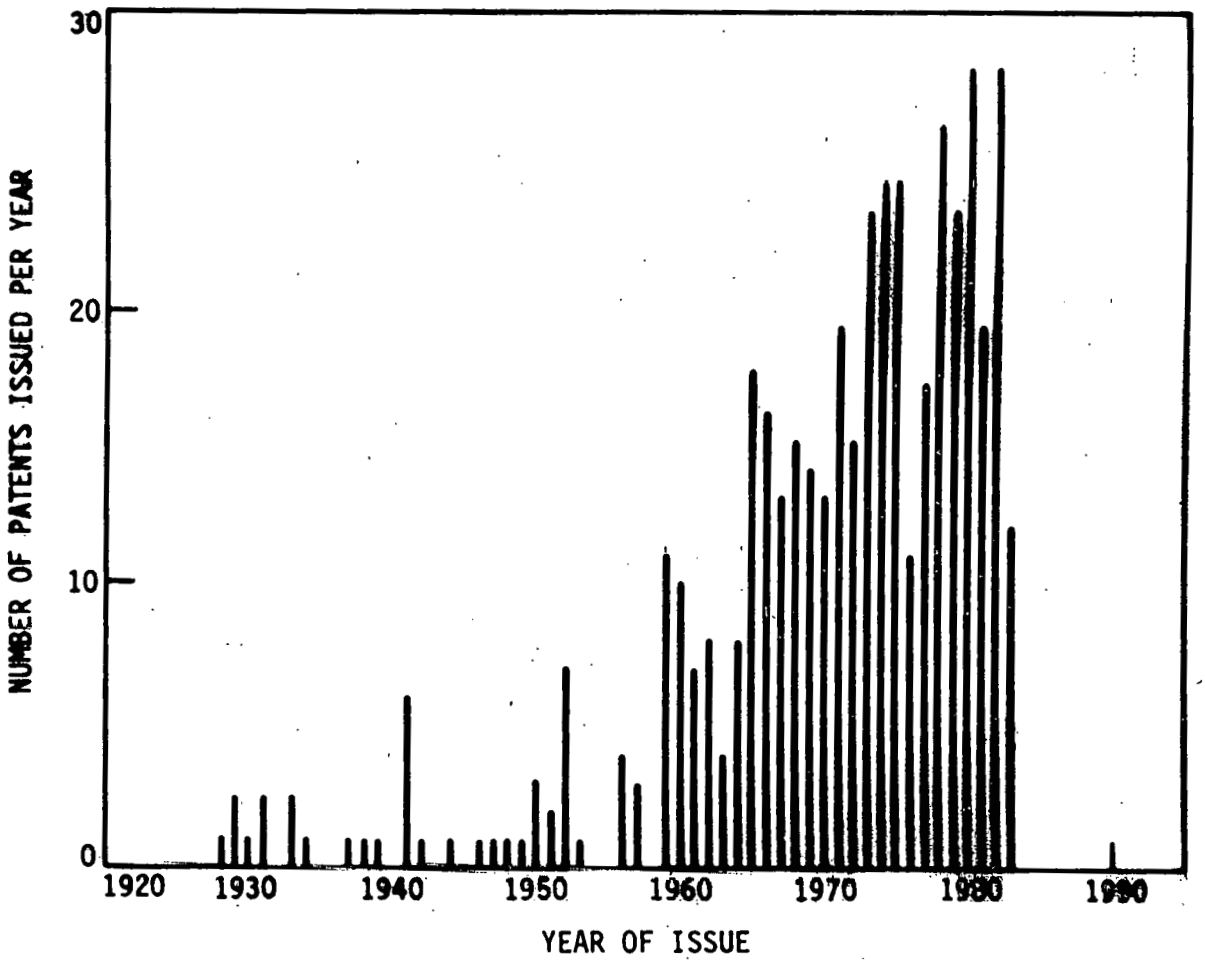

Figure 1. Patents on heat transfer augmentation versus year of publication.

CONCLUDING REMARKS

The present report documents a continuing effort to identify and classify patent literature on heat transfer augmentation technology. While the bibliography should be useful in its present form, several modifications and improvements might be considered in future versions. The bibliography should be annotated to provide a concise description of the technology. This would pin-point more closely the patent copies that the reader might wish to obtain. In addition, foreign patents should be added, as they frequently cover techniques that are not given concurrent U.S. patent protection.

Given the somewhat random nature of patent searches, there are undoubtedly other patents which could be added to this bibliography. The compilers would be grateful if additional patents could be directed to their attention at Iowa State University.

ACKNOWLEDGMENTS

This report was prepared under DOE Grant No. DE-FG07-81ID12222 with the technical cognizance of Dr. W. H. Thielbahr. The valuable assistance of the Iowa State University Research Foundation is acknowledged. The continuous support of the Engineering Research Institute is appreciated.

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2. A. E. Bergles, V. Nirmalan, G. H. Junkhan, and R. L. Webb, "Bibliography on Augmentation of Convective Heat and Mass Transfer-II," Heat Transfer Laboratory Report HTL-31, ISU-ERI-Ames-84221, Iowa State University, December 1983.

3. "Manual of Classification," Basic Manual-December 1982, Revision No. 1, U.S. Department of Commerce, Patent and Trademark Office, Office of Documentation Planning and Support, June 1983.

PAGES 16 to 18

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Table 1.

Class	Subclass	Number of Patents Located with this Primary Classification	Title
2			APPAREL
	7	1	.For wearer's head ..Heat resistant
23			CHEMISTRY, ANALYTICAL AND PHYSICAL PROCESSES
	258.5BH	1	
29			METAL WORKING
	576	1	SEMICONDUCTOR OR BARRIER LAYER DEVICE MAKING Process of making
	597	1	PROCESS OF MECHANICAL MANUFACTURE .Electric devices ..Dynamoelectric machine making ...Commutator or slip ring assembly
	156.8	1	
	157.3R	3	.Gas and water ..Radiators
	157.3A	6	....Finned tubes
	157.3AH	2	....Helical finned tubes
	157.3B	2	....Plural finned tubes
	157.3	12	
	157.4	3	..Boilers, headers and tubes
	191.2	1	
	558	1	.Shaping one-piece blank by removing material ..Successive removal operations
34			DRYING AND GAS OR VAPOR CONTACT WITH SOLIDS
	124	1	APPARATUS .Rotary drums or receptacles ..External ...Heat exchange fluid supply and/or removal
51			ABRADING
	267	1	ACCESSORIES .Cooling ..Wetting grindstones
60			POWER PLANTS
	217	1	REACTION MOTOR .Method of operation ..By chemical reaction ...Injecting mixture of fuel and oxidizer into the reaction zone
62			REFRIGERATION
	5	1	VORTEX TUBE

Table 1. Continued.

Class	Subclass	Number of Patents Located with this Primary Classification	Title
	40	1	SOLIDIFIED OR LIQUEFIED GAS PRODUCT MANUFACTURING FROM A GAS .Liquefied gas producing and separating apparatus ..With external refrigeration producer
	56	1	PROCESSES
	93	1	.Circulating external gas ..With removing of moisture
	98	1	.Fluid external of refrigeration producing cycle
	115	1	.Compressing, condensing and evaporating
	126	1	WITH INDICATOR OR TESTER .Operatively correlated with automatic control
	136	1	AUTOMATIC CONTROL .By congealed removable product condition ..By change of consistency
	285	1	WITH MEANS PREVENTING OR HANDLING ATMOSPHERIC CONDENSATE RELATIVE TO HEAT ABSORBER .Retainer or flow director for atmospheric condensate
	304	1	MATERIAL COOLING MEANS INCLUDING GAS-LIQUID CONTACTOR
	325	1	REVERSIBLE .External fluid flow reversal
	394	1	WITHDRAWABLE LIQUID .Refrigerant evaporator surrounding or within a container
	467	1	
	476	1	REFRIGERATION PRODUCER .Sorbent type
	499	1	..Unitarily movable connected units
72			METAL DEFORMING
	68	2	BY USE OF TOOL ACTING DURING RELATIVE ROTATION BETWEEN TOOL AND WORK ABOUT INTERNAL CENTER .With metal deformation of different type

Table 1. Continued.

Class	Subclass	Number of Patents Located with this Primary Classification	Title
	78	2	.With tool surface orbiting around axis parallel to direction of travel of longitudinally moving work ..Including orbiting roller mounted on rotating carrier
	96	2	.During rotation of work ..And longitudinal movement of work ...Using external rotating tool and internal cone
	98	1	...Using tool-surfaces spaced along axis of work rotation
	299	1	BY USE OF NON-DEFORMING WORK-GRIPPING CLAMP AND RELATIVELY MOVABLE CLAMP, TOOL OR WORK FORCER .With cutting ..With means to rotate clamp about fixed axis ...About axis intersecting work-gripping regions of two clamps
	367	3	PROCESS .Tube making and/or reshaping
77			
	55	1	
82			TURNING
	1C	1	MISCELLANEOUS .. Process of turning
98			
	115	1	
117			
	49	1	
	94	1	
	132	1	
122			LIQUID HEATERS AND VAPORIZERS
	235	1	
	333	1	WATER TUBE .Vertical .Fluid fuel
123			
	8	1	
138			PIPES AND TUBULAR CONDUITS
	37	1	WITH FLOW REGULATORS AND/OR BAFFLES
	38	17	.Heat transfer

Table 1. Continued.

Class	Subclass	Number of Patents Located with this Primary Classification	Title
	39	1	.Flow facilitating
	114	1	PLURAL DUCT .Coaxial
	121	1	FLEXIBLE .Corrugated
	142	1	DISTINCT LAYERS .Bonded to each other ..Brazed, soldered or welded
	177	1	STRUCTURE
148			
	11.5	1	
153			
	13A	1	
	71	2	
158			
	78	1	
	1	1	
	113	1	
159			CONCENTRATING EVAPORATORS
	13	1	
	16	1	
	28D	1	CLOSED EVAPORATING CHAMBERS .Indirectly heated ..Heating elements ....Tubular inserts
164			
	278	1	
165			HEAT EXCHANGE
	1	37	PROCESS
	2	1	.Heating and cooling
	6	1	REGENERATOR .Movable heat storage mass with enclosure
	12	1	TIME OR PROGRAM ACTIVATOR
	40	1	AUTOMATIC CONTROL .Heating and cooling ..Flow of heat exchanging material controlled by its own condition
	67	1	WITH EXTERNAL SUPPORT
	68	1	.Legs
	74	2	COVERED ACCESS OPENING .Cover is, or carries, heat exchanging means ..Heat exchanging means projects into the covered chamber
	76	2	WITH REPAIR OR ASSEMBLY MEANS
	80	1	WITH RETAINER.....

Table 1. Continued.

Class	Subclass	Number of Patents Located with this Primary Classification	Title
	85	1	AGITATOR OR IMPELLER MOTOR OPERATED BY EXCHANGE FLUID
	86	2	MOVABLE HEATING OR COOLING SURFACE
	87	1	.Hollow screw type impeller
	91	1	..With drum surface scraper
	92	2	.Hollow stirrer or scraper
	94	2	WITH SCRAPER REMOVING PRODUCT FROM TEMPERATURE MODIFYING SURFACE
	104.21	2	INTERMEDIATE FLUENT HEAT EXCHANGE MATERIAL RECEIVING AND DISCHARGING HEAT .Liquid fluent heat exchange material ..Utilizing change of state
	104.25	1	....By application of mechanical energy
	105	8	
	106	1	
	109	8	
	109R	1	RECIRCULATION WITH AGITATING OR STIRRING STRUCTURE
	109T	1	..Turbulator in conduit
	110	15	WITH FIRST FLUID HOLDER OR COLLECTOR OPEN TO SECOND FLUID
	111	3	.Separate external discharge port for each fluid
	113	1	..With downstream pressure or temperature modifier ...Surface-type heat exchanger
	115	1	.Trickler
	118	1	..Vertical cone or drum
	122	3	WITH IMPELLER OR CONVEYOR MOVING EXCHANGE MATERIAL .Mechanical gas pump ..Heating or cooling means and gas pump in housing
	124	1	...Verging gas flow
	133	30	WITH COATED, ROUGHENED OR POLISHED SURFACE
	135	1	WITH THERMAL OR ACOUSTICAL BLOCKER

Table 1. Continued.

Class	Subclass	Number of Patents Located with this Primary Classification	Title
	140	3	THREE NON-COMMUNICATING FLUIDS
	141	4	.Concentric flow chamber
	146	2	GRADATED HEAT TRANSFER STRUCTURE
	147	1	.Tapered conduit means
	148	5	RADIATOR CORE TYPE
	149	1	.With edge cover or frame means
	151	5	.Side-by-side tubes traversing fin means
	152	2	.Deformed sheet forms passages between side-by-side tube means
	153	2	..With tube manifold
	154	4	NON-COMMUNICATING COAXIAL ENCLOSURES
	155	2	.With communicating coaxial enclosure
	160	3	CASING OR TANK ENCLOSED CONDUIT ASSEMBLY .With distinct flow director in casing ..Longitudinal
	162	1	.With support in casing
	163	2	.Conduit coiled within casing
	164	1	FLOW PASSAGES FOR TWO CONFINED FLUIDS
	165	5	.Interdigitated plural first and plural second fluid passages
	166	23	..Stacked plates or shells form interplate passages
	167	6	...With plate traversing passages interconnecting alternate spaces
	170	2	CONDUIT WITHIN, OR CONFORMING TO, PANEL OR WALL STRUCTURE .Opposed plates or shells
	172	1	SIDE-BY-SIDE TUBULAR STRUCTURES OR TUBE SECTIONS
	173	1	.With manifold type header or header plate
	175	1	..Inlet and outlet header means
	177	4	TUBULAR STRUCTURE
	179	23	.Projecting internal and external heat transfer means
	181	13	.With discrete heat transfer means

Table 1. Continued.

Class	Subclass	Number of Patents Located with this Primary Classification	Title
	182	1	..With means spacing fins on structure
	184	9	...Helical
	185	6	HEAT TRANSMITTER
	186	2	MISCELLANEOUS
174			ELECTRICITY, CONDUCTORS AND INSULATORS
	15	2	
	15R	1	WITH FLUIDS OR VACUUM .With cooling and/or fluid feeding circulating or distributing
	16	1	
183			
	2	1	
202			DISTILLATION: APPARATUS
	173	1	APPARATUS .Systems ..Separatory ...Still ....Plural .....Series
	185	1	
	189	1	....With vapor-treating devices .....Condenser .....Still supported
	236	1	.Types ..Separatory ...Still ....Spray forming and filming
203			DISTILLATION: PROCESSES, SEPARATORY
	10	1	WATER PURIFICATION ONLY
	11	1	.Under pressure or vacuum
204			CHEMISTRY, ELECTRICAL AND WAVE ENERGY
	29	1	PROCESSES AND PRODUCTS .Electrolysis ..Coating ...Combined ....With base treatment
210			
	57	1	
219			ELECTRIC HEATING
	19	1	
244			
	1	1	
257			
	1	1	
	43	1	
	58	1	

Table 1. Continued.

Class	Subclass	Number of Patents Located with this Primary Classification	Title
	73	2	
	79	2	
	101	1	
	112	1	
	233	1	
	236	1	
	245	13	
	248	1	
	250	4	
	256	1	
	259	1	
	262	5	
	262.13	1	
	262.14	1	
	262.16	1	
	262.18	1	
	262.20	2	
259			
	9	1	
261	99	1	GAS AND LIQUID CONTACT APPARATUS CONTACT DEVICES .Porous mass ..Liquid-flow control ...Capillary feed
	104	2	.Porous sheet ..Surface contact ...Capillary feed
	114R	1	.Wet baffle ..Overflow baffles
263			
	21	1	
266			
	24	1	
313			ELECTRIC LAMP AND DISCHARGE DEVICES
	12	2	WITH TEMPERATURE MODIFIER .Recirculating systems
	21	1	.Electric heater ..For conductive envelope devices ...Cylindrical electrode type envelope
	60	1	
317			
	234	1	
427			
	299	1	
NO CLASS		7	

Table 2. Patent count by technique-mode.

	Technique	Mode					
		1 Natural convection	2 Forced convection	3 Pool boiling	4 Flow boiling	5 Condensation	6 Mass transfer
01	Treated surfaces	0	0	13	2	21	0
02	Rough surfaces	0	33	19	4	8	1
03	Attached promoters	0	17	3	0	3	0
04	Extended surfaces	5	127	29	2	15	2
05	Displacement enhancement devices	0	3	0	2	0	0
06	Formed channels	0	51	1	0	11	0
07	Swirl flow devices	0	14	2	3	2	1
08	Surface tension devices	1	1	7	3	14	1
09	Additives for liquids	0	1	0	1	0	0
10	Additives for gases	1	1	0	0	3	0
11	Mechanical aids	0	24	1	0	0	0
12	Surface vibration	0	1	0	0	0	0
13	Fluid vibration	0	2	1	0	0	0
14	Electrostatic fields	7	10	0	0	2	0
15	Injection or suction	0	3	2	1	1	0
16	Compound enhancement	0	2	0	0	2	0

LIST BY PATENT NUMBER

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1928 Aug. 7,
022D
Heat Exchanger

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153F
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Heat Transmitting Tube

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Heat Transfer Unit

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042B
Heat Exchange Element and Method of Making the Same

2,247,243 Kritzer, R.W.
1941 June 24
29/157.3
042C
Heat Exchange Element and Method of Making the Same

2,279,548 Bailey, E.G.
1942 April 14,
122/235
023A
Liquid Vaporizing Tube

2,360,094 Arvins, N.A.; and Arvintz, A.A.
1944 Oct. 10,
257/233
072F
Heat Exchanger

2,394,698 Kuenhold, O.J. Sr.
1946 Feb. 12,
261/104
015F
Evaporator

2,432,308 Goodyer, H.J.
1947 Dec. 9,
210/57
042A
Conduit Having Annular Ribs, A Sump, And Sediment Directing Means

2,439,775 Kennedy, W.W.
1948 April 13,
257/259
112
Heat Exchanger

2,463,997 Rodgers, J.S.
1949 March 8,
29/157.3
042A
Method Of Making Externally And Internally Finned Tubes

2,463,997 Rodgers, J.S.
1949 March 8,
29/157.3
042C
Method Of Making Externally And Internally Finned Tubes

2,514,797 Robinson, R.S.
1950 July 11,
257/73
132A
Heat Exchanger

2,517,654 Gaugler, R.S.
1950 Aug. 8,
261/99
073F
Refrigerating Apparatus

2,517,654 Gaugler, R.S.
1950 Aug. 8,
261/99
083F
Refrigerating Apparatus

2,529,013 Gloyer, W.
1950 Nov. 7,
257/245
032D
Heat Exchanger

2,553,142 McCreary, K.
1951 May 15,
29/157.3
042C
Method For Making Heat Exchangers

2,565,221 Gaugler, R.S.
1951 Aug. 21,
261/104
023A
Refrigerating Apparatus

2,591,878 Rogers, P.S. ETAL
1952 April 8,
257/245
032D
Oxygen Regenerator

2,604,936 Kaehni, W.L.; and Kaehni, P.J.
1952 July 29,
158/113
141F
Method And Apparatus For Controlling the Generation Of Heat

2,605,377 Kaehni, W.L.; and Kaehni, P.J.
1952 July 29,
219/19
142A
Heat Exchange Method And Apparatus

2,610,835 Hytte, R.P.L.
1952 Sept. 16,
257/245
062D
Plate Heat Exchanger

2,613,066 Newlin, J.S.
1952 Oct. 7,
257/262.20
042B
Finned Tube Construction

2,617,634 Jendrassik, G.
1952 Nov. 11,
257/245
062D
Heat Exchanger

2,623,736 Hytte, R.P.L.
1952 Dec. 30,
257/245
062D
Plate Type Pasteurizer

2,664,274 Worn, G.A.; and Rubin, P.L.
1953, Dec. 29,
257/73
132A
Method And Apparatus Employing Sonic Waves In Heat Exchange

2,729,266 Humphrey, R. P.
1956 Jan. 3; General Gas Light Company
153/71
062A
Apparatus and Method for Making Spirally Corrugated Metal Tubes

2,731,241 Christian, J. D.
1956 Jan 17,
257/79
112C
Heat Exchange Device

2,733,898 Christian, J. D.
1956 Feb. 7,
257/101
112C
Hollow Screw Conveyor Flight

2,753,159 Christian, J. D.
1956 July 3, Holo-Flite Inc.
257/79
112C
Heat Transfer Device

2,789,797 Simpelaar, C.S.
1957 April 23,
257/245
042E
Heat Exchanger Fin Structure

2,790,310 Green, F.H.
1957 April 30,
62/136
152
Axial Flow Vortex Tube Mechanism

2,813,701 Fenger, C.
1957 Nov. 19,
257/245
045E
Cross Flow Heat Exchanger

2,870,999 Soderstrom, S.H.
1959 Jan. 27,
257/262.20
042C
Heat Exchange Element

2,872,165 Wennerberg, P.J.
1959 Feb. 3,
257/245
062D
Plate Type Heat Exchangers

2,873,954 Protze, C.
1959 Feb. 17, Telefunken GmbH, Berlin
257/250
033F
Heat Exchanger for Electric Discharge Tube

2,877,000 Person, F.W.
1959 March 10,
257/245
042E
Heat Exchanger

2,890,722 Loebel, F.A.; and Ewing, R.
1959 June 16,
138/38
162A
Heat Exchanger Tube

2,892,618 Holm, S.
1959 June 30,
257/245
042E
H-X And Cores And Extended Surface Elements Therefor

2,895,508 Drake, C.E.
1959 July 21,
138/38
042A
Heat Exchanger Conduit

2,905,447 Huet, A.
1959 Sept. 22,
257/262.14
042C
Tubular Heat Exchanger

2,916,807 Christian, J. D.
1959 Dec. 15,
29/156.8
112C
Heat Exchange Equipment

2,917,284 Christian, J. D.
1959 Dec. 15,
257/112
112C
Heat Exchange Apparatus

2,919,115 Vaaler, L.E.
1959 Dec. 29,
257/58
015F
Impregnated Porous Condenser Surface

2,923,640 Buckingham, W.T.
1960 Feb. 2,
117/49
015B
Method Of Applying A Plastic Coating

2,932,491 Miller, L.M.
1960 April 12,
257/256
062D
Heat Transfer Unit

2,935,305 Beurtheret, C.A.E.
1960 May 3,
257/250
142F
Electric Discharge Device Cooling System

2,935,306 Beutheret, C. A. E.
1960 May 3, General Electric Company
257/250
043F
Vapor Cooling Apparatus for Electric Discharge Devices

2,947,152 Bloem, A.T.
1960 Aug. 2,
62/40
045P
H-X For Seperating Out Constituents From A Gas By Cooling

2,950,604 Gambill, W.R.; and Greene, N.D.
1960 Aug. 30,
62/5
074A
Heat Transfer Method

2,952,444 Jenssen, S.K.
1960 Sept. 13,
257/245
062D
Heat Exchangers Of The Plate Type

2,958,021 Cornelison, B.; and Wolff, E.A. Jr.
1960 Oct. 25,
317/234
043A
Cooling Arrangement For Transistors

2,960,114 Hinde, J.N.
1960 Nov. 15,
138/38
043A
Innerfinned Heat Transfer Tubes

2,962,265 Van Luik, Jr., F.W.
1960 Nov. 29,
257/43
145B
Vapor-Liquid Phase Conversion

2,962,265 Van Luik, Jr., F.W.
1960 Nov. 29,
257/43
145C
Vapor-Liquid Phase Conversion

2,969,957 Beurtheret, C.A.E.
1961 Jan 31, Compagnie Francaise Thomson-Houston
257/250
043F
Electric Discharge Device Cooling Systems

2,970,669 Berqson, G.
1961 Feb. 7,
183/2
085A
Condensing Filter

2,978,797 Ekelund, A.E.
1961 April 11,
29/157.3
042C
Tubular Finned Metal Section And Manufacture Thereof

2,983,115 Caswell, H.E.
1961 May 9,
62/285
045C
Heat Transfer Device With Condensate Drainage Means

2,985,434 Boring, S.A.;Speca, E.J.; and Zierak, S.J.
1961 May 23,
257/245
042D
Regenerator

2,995,344 Hryniszak, W.
1961 Aug. 8,
257/245
062D
Plate Type Heat Exchanger

2,998,228 Huet, A.
1961 Aug. 29,
257/262.18
042C
Surface Heat Exchangers

3,015,355 Humphrey, A.H.
1962 Jan. 2, General Gas Light Company
153/78
022A
Method for Forming Spirally Ribbed Tubing

3,022,049 Abbott, R.W.
1962 Feb. 20,
257/262.13
042B
Heat Exchange Tubing

3,033,536 Guszmann, M.
1962 May 8,
257/262.16
042B
Radiator System

3,045,138 Pohl, W.J.
1962 July 17,
313/21
023C
Electrical Discharge Tube

3,046,428 Beurtheret, C. A. E.
1962 July 24, Compagnie Francaise Thomson-Houston
313/12
043F
High Frequency Energy Interchange Device

3,046,429 Beurtheret, C. A. E.
1962 July 24, Compagnie Francaise Thomson-Houston
313/12
043F
High Frequency Energy Interchange Device

3,055,643 Beurtheret, C.A.E.
1962 Sept. 25,
257/250
073A
Heat Exchangers

3,056,587 Steigerwald, K.H.
1962 Oct. 2,
257/1
142F
Methods Of Effecting A High Rate Of H.T. From A Heated Surf, etc.

3,071,159 Coraggioso, C.B.
1963 Jan. 1,
138/38
072A
Heat Exchange Tube

3,088,494 Koch, P.H.; Pirsh, E.A.; and Swenson, H.S.
1963 May 7,
138/37
043A
Ribbed Vapor Generating Tubes

3,089,318 Hebeler, H.K.
1963 May 14,
62/467
043F
Hypersonic Cooling System

3,111,168 Huet, A.
1963 Nov. 19,
165/165
042C
Heat Exchangers

3,117,625 Fraenkel, S.J.
1964 Jan. 14, Stanray Corp.
165/185
042F
Filling Material for Heat Exchangers

3,128,821 Andersen, R. C.
1964 Apr. 14, Flexonics Corp.
153/71
022A
Corrugator for Metal Tubing

3,128,821 Andersen, R. C.
1964 Apr. 14, Flexonics Corp.
153/71
042C
Corrugator for Metal Tubing

3,137,184 Meyers, P.G.
1964 June 16,
77/55
141F
Tool Cooling Apparatus

3,152,774 Wyatt, T.
1964 Oct. 13,
244/1
083F
Satellite Temperature Stabilization System

3,152,774 Wyatt, T.
1964 Oct. 13,
244/1
085F
Satellite Temperature Stabilization System

3,154,141 Huet, A.
1964 Oct. 27,
165/133
022C
Roughened Heat Exchanger Tube

3,156,455 Boulet, C.
1964 Nov. 10, Holo-Flite Intl. Inc.
263/21
112B
Methods of Effecting Heat Exchange and Heat Transfer Devices Therefor

3,163,207 Schultz, R.T.
1964 Dec. 29,
165/68
042F
Heat Dissipating Mount For Electronic Components

3,167,927 Lynch, P.J.; and Taylor, P.L.
1965 Feb. 2,
62/56
015F
Promotion Of Dropwise Condenstion

3,174,319 Koyama, S.; Shida, J.; and Nakayama, K.
1965 March 23,
72/96
042B
Method And Apparatus For Manufacturing Integrally Finned Tubing

3,175,960 Kassat, H.
1965 March 30,
202/189
045B
Air Cooled Condenser For Distilling Apparatus

3,187,812 Staver, E.F.
1965 June 8,
165/185
042E
Heat Dissipator For Electronic Circuitry

3,196,634 Rich, D.G.
1965 July 27,
62/394
015C
Refrigeration System

3,202,210 Hughes, R.W.
1965 Aug. 24,
165/154
032C
Heat Exchanger

3,202,212 Kritzer, R.W.
1965 Aug. 24,
165/179
042B
Heat Transfer Element

3,206,381 Neugebauer, F.J.; and Lustenader, E.L.
1965 Sept. 14,
202/185
015F
Dropwise Condensation Distillation Apparatus

3,207,209 Hummel, R.L.
1965 Sept. 21,
165/1
013F
Means For Increasing The H.T. Coeficient Between A Wall And etc.

3,207,216 Donaldson, D.M.
1965 Sept. 21,
165/148
062D
Heat Exchanger

3,209,062 Scholz, C.F.
1965 Sept. 28,
174/15
042E
Mounting And Cooling Syst. For Semi-Conductor Heat Generating Dev.

3,213,525 Creighton, W.M.; Evans, S.O.; and McMurdy, A.E.
1965 Oct. 26,
29/157.3
062A
Method of Forming An Internal Rib In The Bore Of A Tube

3,215,196 Pauls, T.F.
1965 Nov. 2,
165/179
042C
Metal Fabrication

3,217,799 Rodgers, J.S.
1965 Nov. 16,
165/179
025A
Steam Condenser Of The Water Tube Type

3,221,399 Karmazin, J.
1965 Dec. 7,
29/157.3
042B
Method Of Manufacturing Heat Exchanger

3,224,485 Blomgren, O.C. Sr. ETAL
1965 Dec. 21,
158/1
141A
Heat Control Device And Method

3,224,497 Blomgren, O.C. Sr. ETAL
1965 Dec. 21,
165/2
141F
Method And Apparatus For Lowering The Temperature Of A Heated Body

3,224,497 Blomgren, O.C. Sr. ETAL
1965 Dec. 21,
165/2
142F
Method And Apparatus For Lowering The Temperature Of A Heated Body

3,225,824 Wartenberg, K.
1965 Dec. 28,
165/122
045E
Air Cooled Heat Exchanger For Cooling Liquid Media

3,228,464 Stein, W.J.; and Banthin, C.R.
1966 Jan. 11,
165/166
062D
Corrugated Plate Counter Flow Heat Exchanger

3,229,722 Kritzer, R.W.
1966 Jan. 18,
138/39
042A
Heat Exchange Element With Internal Flow Diverters

3,229,759 Grover, G.M.
1966 Jan. 18,
165/105
015F
Evaporation-Condensation Heat Transfer Device

3,229,759 Grover, G.M.
1966 Jan. 18,
165/105
083F
Evaporation-Condensation Heat Transfer Device

3,229,759 Grover, G.M.
1966 Jan. 18,
165/105
085F
Evaporation-Condensation Heat Transfer Device

3,232,341 Woodworth, L.R.
1966 Feb. 1,
165/111
075A
Condenser

3,235,004 Beurtheret, C.
1966 Feb. 15, Compagnie Francaise Thomson-Houston
165/185
043F
Heat Dissipating Structure

3,240,683 Rogers, F.A.
1966 March 15,
202/173
065D
Distillation Apparatus For Treating Sea Water To Produce etc.

3,244,601 Diedrich, G.E.
1966 April 5,
202/236
025C
Fluted Tubular Distillation Apparatus

3,247,583 Hansson, A.; and Brick, R.M.
1966 Apr. 26, Continental Can Company, Inc.
29/157.3
032F
Production of Externally Finned Sheet Stock

3,261,905 Allen, B.F.
1966 July 19, General Electric Company
174/15
153F
Stationary Induction Apparatus Cooling System

3,267,564 Keyes, J.M.
1966 Aug. 23,
29/157.3
042A
Method Of Producing Duplex Internally Finned Tube Units

3,269,459 Popovitch, D.
1966 Aug. 30,
165/140
042B
Extensive Surface Heat Exchanger

3,273,599 Heeren, H.
1966 Sept. 20,
138/38
042A
Internally Finned Condenser Tube

3,273,599 Heeren, H.
1966 Sep. 20
138/38
045A
Internally Finned Condenser Tube

3,288,209 Wall, A.J.; and Palmer, A.
1966 Nov. 29,
165/184
042B
Heat Transmitting Tubes Having Helical Fin Means

3,289,752 Staub, F.W.
1966 Dec. 6,
165/110
035D
Condensing Heat Transfer Device

3,289,756 Jaeger, U.R.
1966 Dec. 6, Olin Mathieson Chemical Corporation
165/155
042C
Heat Exchanger

3,294,162 Loehlein, H.J.; and Curran, E.E.
1966 Dec. 27,
165/181
042C
Heat Exchanger Construction And Method For Making The Same

3,295,599 Okamoto, Y. ETAL
1967 Jan. 3,
165/184
042B
Heat Transfer Fin Heat Exchanging Tube

3,298,427 Erb, R.A.
1967 Jan. 17,
165/1
015F
Method And Apparatus For Dropwise Condensation

3,299,949 Beurtheret, C.A.E.
1967 Jan. 24,
165/185
043C
Device For Evaporative Cooling Of Bodies And Power Vacuum etc.

3,301,314 Gaertner, R.F.
1967 Jan. 31,
165/1
015F
Method And Means For Increasing The H.T. Coefficient etc.

3,302,701 Thomas, D.G.
1967 Feb. 7,
165/109
022F
Turbulence Promoter For Increased Heat And Mass Transfer

3,302,701 Thomas, D.G.
1967 Feb. 7,
165/109
026F
Turbulence Promoter For Increased Heat and Mass Transfer

3,306,350 Beurtheret, C.A.E.
1967 Feb. 28, Compagnie Francise Thomson Houston-Hotchkiss Brandt
165/105
043F
Electron Discharge Tube Having Improved Cooling Means Therefor

3,311,165 Karmazin, J.
1967 March 28,
165/109
062D
Heat Exchanger

3,326,283 Ware, C.D.
1967 June 29,
165/181
043C
Heat Transfer Surface

3,330,336 Gobel, G.
1967 July 11,
165/160
032C
Heat Exchanger Tubes With Longitudinal Ribs

3,339,631 McGurty, J.A.; and Necker, W.C.
1967 Sept. 5,
165/109
043A
Heat Exchanger Utilizing Vortex Flow

3,347,059 Laing, N.
1967 Oct. 17,
62/325
112
Heat Pump

3,358,750 Thomas, D.G.
1967 Dec. 19,
165/177
035C
Condenser Tube

3,360,040 Kritzer, R.W.
1967 Dec. 26,
165/181
042B
Heat Exchanger Elements

3,363,682 Hartley, D.E.
1968 Jan. 16,
165/181
042E
Heat Exchangers Having Vortex Producing Vanes

3,367,415 Beurtheret, C.A.E.
1968 Feb. 6, Compagnie Francaise Thomson Houston-Hotchkiss Brandt
165/185
043F
Anisotherm Evaporation Heat-Transfer Structure

3,368,610 Kartluke, H.; and Boyd, C.A.
1968 Feb. 13,
165/1
133F
Superheating Prevention And Boiling Control

3,370,644 Daily, W.B.; and Speca, E.J.
1968 Feb. 27,
165/1
142A
Method Of Increasing The Rate Of Heat Transfer

3,371,709 Rosenblad, C.F.
1968 March 5,
165/115
065D
Falling Film Plate Heat Exchanger

3,384,154 Milton, R.M.
1968 May 21,
165/1
015C
Heat Exchanger System

3,384,160 Beurtheret, C.A.
1968 May 21, Compagnie Francaise Thomson Houston-Hotchkiss Brandt
165/74
043F
Non-Isothermal Evaporation Type Heat Transfer Apparatus

3,384,165 Mathews, R.T.
1968 May 21,
165/122
042B
Heat Exchanger

3,390,667 Beutheret, C. A. E.
1968 July 2, Compagnie Francaise Thomson Houston-Hotchkiss Brandt
123/8
043F
Two-Stage Cooling System for Heat Machine Components

3,392,781 Zuber, N.; and Lustenader, E.L.
1968 July 16,
165/135
023A
Vaporizing Heat Transfer Device

3,394,736 Pearson, J.F.
1968 July 30,
138/38
042A
Internal Finned Tube

3,397,440 Dalin, D.
1968 Aug. 20,
29/157.3
022C
Method Of Making Heat Exchanger Having Extended Surface

3,398,784 Smith, J.W.; and Gowen, R.A.
1968 Aug.27,
165/1
022A
Method Of Heat Exchange With High Viscosity Liquids

3,407,871 Penney, W.R.
1968 Oct.29,
165/85
072A
Heat Exchanger

3,410,533 Penney, W.R.
1968 Nov. 12,
259/9
112A
Mixing Equipment

3,422,518 French, P.W.
1969 Jan. 21,
29/157.3
042A
Method Of Reforming Tubular Metal Blanks Into Inner Finned Tubes

3,423,294 Sephton, H.H.
1969 June 21,
203/10
074A
Vortex Flow Film Distillation Process

3,433,294 Timson, W.J.
1969 March 18,
165/1
015F
Boiling Heat Transfer System

3,438,433 Gunter, A.Y.
1969 April 15, Hudson Engineering
165/151
042B
Plate Fins

3,448,791 Clark, J.
1969 June 10,
165/1
142F
Methods And Apparatuses For Energy Transfer

3,450,193 Wolfe, W. Jr.
1969 June 17,
165/1
045C
Corrugated Tubing

3,452,147 Narbut, P.; and Moore, C.L.
1969 June 24,
174/16
101F
Noncondensable Gas - Condensable Vapor Cooled Electri. Transformer

3,454,081 Kun, L.C.; and Czikk, A.M.
1969 July 8,
165/133
023A
Surface For Boiling Liquids

3,455,376 Beurtheret, C.A.E.
1969 July 15,
165/1
043E
Heat Exchanger

3,457,982 Sephton, H. H.
1969 July 29,
159/13
076A
Evaporation and Distillation Apparatus

3,457,990 Theophilos, N.P.; and Wang, D.I.J.
1969 July 29,
165/133
023A
Multiple Passage Heat Exchanger Utilizing Nucleate Boiling

3,457,990 Theophilous, N.P.; and Wang, D.I.J.
1969 July 29,
165/133
045A
Multiple Passage Heat Exchanger Utilizing Nucleate Boiling

3,466,189 Erb, R.A.
1969 Sept. 9,
117/132
015F
Method For Improving Heat Transfer In Condensers

3,469,626 Wright. F.W.; and Wilson, A.H.
1969 Sept. 30,
165/166
062D
Plate Heat Exchangers

3,481,394 Withers, J.G. Jr.
1969 Dec. 2,
165/179
045C
Configuration Of H.T. Tubing For Vapour Condensation etc.

3,502,137 Pawlowski, J.
1970 March 24,
165/1
112
Method Of Intensifying H.T. In Worms Having A Single Spindle

3,508,608 Roe, R.C.
1970 April 28,
165/179
085C
Condenser Tubes

3,521,705 Beutheret, C. A.; and Douguet, E. J.
1970 July 28, Compagnie Francaise Thomson Houston-Hotchkiss Brandt
165/74
023C
Heat Exchange Structure and Electron Tube Including Such Exchange Structure

3,521,708 Webb, R.L.
1970 July 28,
165/186
043C
Heat Transfer Surface Which Promotes Nucleate Ebullition

3,523,577 Milton, R.M.
1970 Aug. 11,
165/110
015C
Heat Exchange System

3,526,268 Robinson, M.
1970 Sept. 1,
165/1
142F
Corona Discharge Heat Transfer

3,528,494 Levedahl, W.J.
1970 Sept. 15,
165/105
045A
Heat Pipe For Low Thermal Conductivity Working Fluids

3,529,661 Tousch, T.
1970 Sept. 22,
165/87
112B
Rotary Material Processor with Hollow Material Contacting Elements

3,532,161 Lockel, F.A.
1970 Oct. 6,
165/167
062D
Plate Type Heat Exchanger

3,533,267 Bunnell, T. R.
1970 Oct. 13, Turbotec, Inc.
72/299
062A
Method and Machine for Spirally Corrugating Tubes

3,534,555 Webb, J.E.
1970 Oct. 20,
60/217
092A
Laminar Flow Enhancement

3,540,530 Kritzer, R.W.
1970 Nov. 17,
165/146
042B
Graduated Heat Exchanger Fins

3,547,185 Eissenberg, D.M.
1970 Dec. 15,
165/1
105C
Method For Promoting Dropwise Condensation On Copper etc.

3,559,437 Withers, Jr., J.G.
1971, Feb. 2
72/96
022A
Method and Apparatus for Making Heat Transfer Tubing

3,559,437 Withers, Jr., J.G.
1971, Feb. 2
72/96
045C
Method and Apparatus for Making Heat Transfer Tubing

3,559,722 Schauls, J.L.; and Duncan, F.D.
1971 Feb. 2,
159/16
062D
Method And Apparatus For Two Phase H.X. Fluid Distribution etc.

3,566,514 Szumigala, E.T.
1971 March 2,
29/558
023F
Manufacturing Method For Boiling Surfaces

3,578,075 Winter, J.
1971 May 11,
165/177
022C
Corrugated Tubing

3,587,730 Milton, R.M.
1971 June 28,
165/110
015C
Heat Exchange System With Porous Boiling Layer

3,590,917 Huber, J.; and Poth, L.
1971 July 6,
165/167
062D
Plate Type Heat Exchanger

3,595,299 Weishaupt, J.; Waldman, H.; and Haring, T.
1971 July 27,
159/28D
032A
Apparatus For The Evaporation Of Low Temp. Liquified Gases

3,595,310 Burne, F.A.
1971 July 27,
165/181
042B
Modular Units And Use Thereof In Heat Exchangers

3,596,495 Huggins, H.D.
1971 Aug. 3,
72/367
042A
Heat Transfer Device And Method Of Making

3,598,180 Moore, R.D. Jr.
1971 Aug. 10,
165/133
083C
Heat Transfer Surface Structure

3,602,027 Klug, W.A.; and Ware, C.D.
1971 Aug. 31, The Trane Company
72/98
023B
Simultaneous Finning and Reforming of Tubular Heat Transfer Surface

3,602,027 Klug, W.A.; and Ware, C.D.
1971 Aug. 31, The Trane Company
72/98
042C
Simultaneous Finning and Reforming of Tubular Heat Transfer Surface

3,603,384 Huggins, H.D.; and Dudley, C.J.
1971 Sept. 7,
165/181
042B
Expandable Tube And Heat Exchanger

3,604,504 Kessler, S.W. Jr.; and Hess, J.L.
1971 Sept. 14,
165/105
083A
Flexible Heat Pipe

3,605,872 Brault, J.
1971 Sept. 20,
165/1
072A
Method Causing Liquid To Flow In Stream Of Annular Cross Section

3,608,629 Cowans, K.W.
1971 Sept. 28,
165/165
062D
Flow Compensator For Exchanger Apparatus

3,612,175 Ford, J.A.; and Wolfe, W. Jr.
1971 Oct. 12,
165/179
022C
Corrugated Metal Tubing

3,613,779 Brown, C.E.
1971 Oct. 19,
165/133
085C
Apparatus For Obtaining High Heat Transfer In Falling Water Film

3,621,905 Hedstrom, B.
1971 Nov. 23,
165/1
094A
Method Of Improving The H.T. In A Tube Of An Evaporrator etc.

3,622,403 French, F.W.
1971 Nov. 23,
148/11.5
022A
Production Of Metal Tubing With Rough Inner Surfaces

3,636,982 Drake, C.E.
1972 Jan. 25,
138/38
042A
Internally Finned Tube And Method Of Forming Same

3,648,754 Sephton, H.H.
1972 March 14,
153/13A
074A
Vortex Flow For Enhancing Interfacial Surface & Heat & Mass Transf

3,650,321 Kaltz, K.L.
1972 March 21,
165/106
062D
Sheet Metal Radiator Assembly

3,662,582 French, F.W.
1972 May 16,
72/367
042A
Heat-Exchange Tubing And Method Of Making It

3,665,573 Werner, R.W.; Alexander, E.E.; and Comstock, I.J.
1972 May 30,
29/157.3
083A
Method Of Fabricating A Heat Pipe

3,669,186 Schauls, J.J.
1972 June 13,
165/166
062D
Distributor For Plate Type Heat Exchangers Having End Headers

3,670,606 Blomgren, O.C. Sr.; and Blomgren, O.C. Jr.
1972 June 20,
82/1 C
141F
Method & Apparatus For Cooling Workpiece And/Or The Cutting etc.

3,675,710 Ristow, R.E.
1972 July 11,
165/1
075A
High Efficiency Vapor Condenser and Method

3,675,710 Ristow, R.E.
1972 July 11,
165/1
155A
High Efficiency Vapor Condenser and Method

3,684,007 Ragi, E.G.
1972 Aug. 15,
165/133
033C
Composite Structure For Boiling Liquids And Its Formation

3,687,434 Dyskin, E.M. ETAL
1972 Aug. 29,
266/24
113A
Hollow Tyre Of Rotary Furnaces & Method Of Equalizing Tyre Temp.

3,692,105 O'Connor, J.M.
1972 Sept. 19,
165/181
042B
Heat Exchangers

3,696,861 Webb, R.L.
1972 Oct. 10,
165/133
043C
Heat Transfer Surface Having A High Boiling H.T. Cofficient

3,696,863 Kim, S.C.
1972 Oct. 10,
165/179
042A
Inner-Outer Finned Heat Transfer Tubes

3,705,618 Jouet, E.; and Rebuffe, P.
1972 Dec. 12,
165/166
022F
Heat Exchanger

3,706,127 Oktay, S.; and Schmeckenbecher, A.F.
1972 Dec. 19,
29/576
032D
Method For Forming Heat Sinks On Semiconductor Device Chips

3,706,127 Oktay, S.; and Schmeckenbecher, A.F.
1972 Dec. 19, International Business Machines Corporation
29/576
041F
Method for Forming Heat Sinks on Semiconductor Device Chips

3,724,094 Appel, D.W.; and Hong, S.H.
1973 Apr. 3, Kimberly-Clark Corp.
34/124
112B
Rotary Drying Drum

3,730,229 D'Onofrio, M. L.
1973 May 1, Turbotec, Inc.
138/114
062A
Tubing Unit with Helically Corrugated Tube and Method for Making Same

3,731,732 Awe, R.C.; Burton, J.C.; and Blank, T.G.
1973 May 8,
165/181
042B
Tube And Fin Heat Exchanger

3,734,135 Mosier, J.A.
1973 May 22,
138/38
032A
Heat Exchanger With Internal Turbulater

3,734,140 Nakamura, H.; and Tanaka, M.
1973 May 22,
138/177
022A
Cross-Rifled Vapor Generating Tubes

3,734,140 Nakamura, H.; and Tanaka, M.
1973 May 22,
138/177
024A
Cross-Rifled Vapor Generating Tubes

3,735,175 Blomgren, O.C. Jr.
1973 May 22,
313/60
141F
Method For Removing Heat From Within A Vacuum And From etc.

3,741,285 Kuethe, A.M.
1973 June 26,
165/1
032D
Boundary Layer Control of Flow Separation and Heat Exchange

3,746,086 Pasternak, S.F.
1973 July 17,
165/181
042B
Heat Exchangers

3,747,284 Lyczko, F.J.
1973 July 24,
51/267
142F
Cooling Apparatus

3,747,670 Palm, L.J.; and Palm, R.B.
1973 July 24,
165/1
072F
Thermal Fluid Heater

3,750,709 French, F.W.
1973 Aug. 7,
138/38
042A
Heat Exchanger Tube And Method Of Making It

3,752,228 Bosse, R.C.
1973 Aug. 14,
165/184
042B
I-Type Segmented Finned Tube

3,757,856 Kun, L.C.
1973 Sept. 11,
165/166
062D
Primary Surface Heat Exchanger And Manufacture Thereof

3,759,050 Slaasted, R.S.; and Dudley, J.C.
1973 Sept. 18,
62/93
065D
Method Of Cooling A Gas And Removing Moisture Therefrom

3,759,322 Nasser, G.E.D.; and Waldmann, H.
1973 Sept. 18,
165/166
062D
Heat Exchanger

3,759,323 Dawson, H.J. ETAL
1973 Sept. 18,
165/166
062D
C-Flow Stacked Plate Heat Exchanger

3,762,468 Newson, I.H.; and Hodgson, T.D.
1973 Oct. 2,
165/177
085B
Heat Transfer Members

3,762,468 Newson, I.H.; and Hodgson, T.d.
1973 Oct.2,
165/177
084B
Heat Transfer Members

3,768,290 Zatell, V.A.
1973 Oct. 30,
72/68
043C
Method Of Modifying A Finned Tube For Boiling Enhancement

3,768,291 Rieger, K.K.
1973 Oct. 30, Universal Oil Products
72/78
022A
Method of Forming Spiral Ridges on the Inside Diameter of Externally Finned Tube

3,771,589 Lage, J.R.
1973 Nov. 13,
165/1
032A
Method And Apparatus For Improved Transfer Of Heat

3,776,018 French, P.W.
1973 Dec. 4,
72/367
042A
Tubing With Inner Baffle Fins And Method Of Producing It

3,777,343 Hartford, M. L. D.
1973 Dec. 11, Spiral Tubing Corp.
29/157.3 R
062A
Method for Forming a Helically Corrugated Concentric Tubing Unit

3,779,312 Withers, J.G. Jr.; Habdas, E.P.; and Jurmo, M.W.
1973 Dec. 18,
165/184
022A
Internally Ridged Heat Transfer Tube

3,781,959 O'Connor, J.M.
1974 Jan. 1,
29/157.3B
042B
Method Of Fabricating A Finned Heat Exchange Tube

3,783,938 Chartet, A.
1974 Jan. 8,
165/166
072A
Disturbing Device And Heat Exchanger Embodying The Same

3,789,915 Ford, J.A.
1974 Feb. 5,
165/1
025C
Process For Improving H.T. Efficiency And Improved H.T. System

3,797,559 Paul, R.S.; and Weiler, D.W.
1974 March 19,
165/1
165A
Rotary Heat Exchanger And Apparatus

3,804,159 Searight, E.F.; and Brosens, P.J.
1974 April 16,
165/109
042B
Jet Impingement Fin Coil

3,807,496 Stadmark, N.H.G.
1974 April 30,
165/167
062D
Heat Exchange Plates

3,810,509 Kun, L.C.
1974 May 14, Union Carbide Corp.
165/148
042B
Cross Flow Heat Exchanger

3,814,172 Shore, D.T.
1974 June 4,
165/12
122D
Heat Exchangers

3,818,984 Nakamura, K.; and Kuroyanagi, M.
1974 June 25,
165/166
042E
Heat Exchanger

3,821,018 Grant, A.C.
1974 June 28,
117/94
015C
Porous Metallic Layer Formation

3,825,064 Inoue, K.
1974 July 23,
165/179
015C
Heat Exchanger

3,826,304 Withers, J.G.; Dean, H.R.; and Ross, S.T.
1974 July 30,
165/1
024A
Advantageous Configuration Of Tubing For Internal Boiling

3,827,343 Darm, W.J.
1974 Aug. 6,
98/115
062D
Grease Collecting Heat Exchanger Installation

3,831,664 Pogson, J.T.
1974 Aug. 27,
165/80
062D
Heat Pipe Interfaces

3,831,675 McLain, C.D.
1974 Aug. 27,
165/177
022C
Heat Exchanger Tube

3,837,396 Newton, A.B.
1974 Sept. 24,
165/111
085A
Vertical Surface Vapor Condensers

3,840,069 Fischer, W.; and Gammel, G.
1974 Oct. 8,
165/105
084A
Heat Pipe With A Sintered Capillary Structure

3,844,341 Bimshas, J. Jr.; and Hickey, E.S.
1974 Oct. 29,
165/86
112
Rotatable Finned Heat Exchanger Device

3,845,814 Kun, L.C.
1974 Nov. 5, Union Carbide Corp.
165/148
042B
Finned Primary Surface Heat Exchanger

3,846,254 Sephton, H.H.
1974 Nov. 5,
203/11
085A
Interface Enhancement Applied To Evaporation Of Liquids

3,846,254 Sephton, H.H.
1974 Nov.5.
203/11
042A
Interface Enhancement Applied To Evaporation of Liquids

3,847,212 Withers, J.G. Jr.; and Rieger, K.K.
1974 Nov.12,
165/179
022A
Heat Transfer Tube Having Multiple Internal Ridges

3,850,227 Ford, J.A.
1974 Nov. 26,
165/1
022C
Process For Improving Heat Transfer Efficiency etc.

3,850,234 Fowler, G.
1974 Nov. 26,
165/153
042D
Heat Exchangers

3,856,079 Geppelt, E.W.
1974 Dec. 24,
165/184
042C
Finned Tube Heat Exchange Conductor

3,860,065 Schauls, J.J.
1975 Jan. 14,
165/166
062E
Distributor For Plate Type Heat Exchanger Having Side Headers

3,861,462 McLain, C.D.
1975 Jan. 21,
165/179
022A
Heat Exchange Tube

3,862,661 Kovalenko, L.M. ETAL
1975 Jan. 28,
165/166
062D
Corrugated Plate For H-X And H-X With Said Etc.

3,865,184 Grover. G.M.
1975 Feb. 11,
165/105
022A
Heat Pipe And Method And Apparatus For Fabricating Same

3,870,081 Kleppe, B.; and Torqersen, O.
1975 March 11,
138/38
072A
Heat Exchange Conduit

3,871,407 Bykov, A.V. ETAL
1975 March 18,
138/38
043A
Heat Exchange Apparatus

3,872,917 Blomqren, O.C. Sr.; and Blomqren, O.C. Jr.
1975 March 25,
165/1
142F
Cooling Apparatus And Method For Heat Exchangers

3,875,997 Newson, I.H.; and Hodgson, T.D.
1975 April 8,
165/110
025A
Tubular Heat Transfer Members

3,877,517 Pasternak, S.F.
1975, April 15,
165/146
042B
Heat Exchanqers

3,878,885 Deronzier, J.C. ETAL
1975 April 22,
165/1
105A
Method For Causinq Condensation In Drops On H-X Tubes

3,878,885 Deronzier, J.C. ETAL
1975 April 22,
165/1
105B
Method For Causinq Condensation In Drops On Heat Exchanqer Tubes

3,881,342 Thorne, J.K.
1975 May 6,
72/68
043C
Method For Makinq Integral Finned Tubes For Submerged Boiling

3,885,622 McLain, C.D.
1975 May 27,
165/179
022A
Heat Exchanqer Tube

3,885,936 Limebeer, G.J.N.
1975 May 27,
62/304
042B
Heat Exchangers

3,886,976 Kardas, A.; Larson, D.H.; and Nesbitt, J.D.
1975 June 3,
138/38
052A
Recuperator Having A Reradiant Insert

3,887,004 Beck, T.A.
1975 June 3,
165/179
042A
Heat Exchange Apparatus

3,887,759 Staub, F.W.; and Kosky, P.G.
1975 June 3,
174/15 R
023F
Evaporative Cooling Syst. Employing Liquid Film Evaporation etc.

3,892,273 Nelson, B.E.
1975 July 1,
165/105
083A
Heat Pipe Lobar Wicking Arrangment

3,901,312 Pasternak, S.F.
1975 Aug. 26,
165/181
042B
Heat Exchangers And Method Of Making Same

3,902,552 McLain, C.D.
1975 Sept. 2,
165/179
022A
Patterned Tubing

3,903,962 Newton, A.B.
1975 Sept. 9,
165/110
085A
Condensate Guiding Apparatus For Vertical Condensing Tubes etc.

3,906,604 Kakizaki, K.; and Suzumura, T.
1975 Sept. 23,
29/157.3A
023F
Method For Forming Heat Transmissive Wall Surface

3,906,605 McLain, C.D.
1975 Sept. 23,
29/157.3 R
022A
Process For Preparing Heat Exchanger Tube

3,906,605 McLain, C.D.
1975 Sept. 23,
29/157.3 R
022C
Process For Preparing Heat Exchanger Tube

3,916,984 Properzi, I.
1975 Nov. 4,
164/278
152
Cooling Device For Continuous Casting Machine

3,921,711 Westbrock, A.J.
1975 Nov. 25,
165/109
052A
Turbulator

3,931,854 Ivakhnenko, V.V. ETAL
1976 Jan. 13,
165/166
062D
Plate Type Heat-Exchange Apparatus

3,947,941 O'Connor, J.M.: and Pasternak, S.P.
1976 April 6,
29/157.3B
042B
Method Of Making A Heat Exchanger

3,955,617 Walsh, J.C.
1976 May 11,
165/94
112
Swept Surface Heat Exchanger With Dual Heat Exchange Media

3,973,623 Sarll, P.G.
1976 Aug. 10,
165/94
112
Heat Exchange Apparatus

3,976,126 Ruff, K.
1976 Aug. 24,
165/110
042B
Air Cooled Surface Condenser

3,981,356 Granetzke, D.C.
1976 Sept. 21,
165/179
032A
Heat Exchanger

3,983,191 Schauls, J.J.
1976 Sept. 28,
261/114R
062D
Brazed Plate Type H-X For Nonadiabatic Rectification

3,983,935 Henrion, C.E.
1976 Oct. 5,
165/166
042B
Heat Exchanger

3,989,104 Newton, A.B.
1976 Nov. 2,
165/111
085A
Condenser Inserts

3,990,862 Dahl, M.M.; and Erb, L.D.
1976 Nov. 9,
29/191.2
013F
Liquid Heat Exchanger Interface And Method

3,995,688 Darm, W.J.
1976 Dec. 7,
165/165
062D
Air To Air Heat Exchanger

4, 154,294 Notaro, F.
1979 May 15,
165/133
015C
Enhanced condensation Heat Transfer Device and Method

4,002,201 Donaldson, D.M.
1977 Jan. 11,
165/140
062D
Multiple Fluid Stacked Plate Heat Exchanger

4,007,774 Withers, J.G. Jr.
1977 Feb. 15,
165/1
042A
H-X Apparatus And Method Of Controlling Fouling Therein

4,007,774 Withers, Jr., J.G.
1977 Feb. 15, UOP Inc.
165/1
022A
Heat Exchange Apparatus and Method of Controlling Fouling Therein

4,016,928 Bartels, E.L.; and Fleming, R.B.
1977 April 12,
165/141
062D
Heat Exchanger Core Having Expanded Metal Heat Transfer Surfaces

4,018,264 Albertson, C.E.
1977 April 19,
165/1
015C
Boiling Heat Transfer Surface And Method

4,029,146 Hart, W.F.; and Koenig, R.A.
1977 June 14,
165/166
042E
Corrugated Sheet Heat Exchanger

4,031,602 Cunningham, J.L.; and Campbell, B.J.
1977 June 28,
29/157.3AH
042A
Method Of Making Heat Transfer Tube

4,031,602 Cunningham, J.L.; and Campbell, B.J.
1977 June 28,
29/157.3AH
042C
Method Of Making Heat Transfer Tube

4,034,804 Meijer, R.J.; and Mulder, J.
1977 July 12, U.S. Philips Corp.
165/148
042B
Motor-Car Radiator

4,040,479 Campbell, B.J.; and Rieger, K.R.
1977 Aug. 9,
165/133
043C
Finned Tube Having Enhanced Nucleate Boiling Surface

4,044,796 Smick, R.H.
1977 Aug. 30,
138/38
072A
Turbulator

4,044,797 Fujie, K. ETAL
1977 Aug. 30,
138/38
023A
Heat Transfer Pipe

4,050,507 Chu, R.C.; and Moran, K.P.
1977 Sept. 27,
165/1
023F
Method For Customizing Nucleate Boiling H.T. From Electronic etc.

4,051,898 Yoshino, M.; and Oguri, A.
1977 Oct. 4,
165/166
162F
Static Heat And Moisture Exchanger

4,099,147 Thorne, J.K.
1977 Nov. 22,
165/133
043C
Integral Finned Tube For Submerged Boiling Applications etc.

4,060,125 Fujie, K. ETAL
1977 Nov. 29,
165/133
013C
Heat Transfer Wall For Boiling Liquids

4,060,126 Schladitz, H.J.
1977 Nov. 29,
165/133
022F
H.T. Between Solids And Fluids Utilizing Polycrystalline etc.

4,060,126 Schladitz, H.J.
1977, Nov. 29
165/133
041F
Heat Transfer Between Solids and Fluids Utilizing Polycrystalline Metal

4,064,914 Grant, A.C.
1977 Dec. 27,
138/142
015C
Porous Metallic Layer And Formation

4,065,264 Lewin, J.E.
1977 Dec 27,
23/258.5BH
042C
Blood Oxygenator With Integral H-X For Regulating etc.

4,071,934 Zolman, J.O.; and Griewahn, C.O.
1978 Feb. 7,
29/157.3 A
042B
CPT Box Fin

4,072,182 Cheng, D.Y.
1978 Feb. 7,
165/1
112
Pressure Staged Heat Exchanger

4,073,340 Parker, K.O.
1978 Feb. 14,
165/166
062D
Formed Plate Type Heat Exchanger

4,074,753 Schmittle, K.V.; and Starner, K.E.
1978 Feb. 21,
165/184
043C
Heat Transfer In Pool Boiling

4,086,959 Habdas, E.P.
1978 May 2,
165/155
042C
Automotive Oil Cooler

4,090,559 Megerlin, F.E.
1978 May 23,
165/179
072A
Heat Transfer Device

4,093,755 Dahl, M.M.; and Erb, L.D.
1978, June 6, The Gates Rubber Company
427/299
013B
Method for Making a Liquid Heat Exchanger Coating

4,094,165 Sisk, F.J.
1978,June 13,
62/115
112
Loss Heat Suppression Apparatus And Method For Heat Pump

4,094,170 Kantor, F.W.
1978 June 13,
62/499
112
Rotary Thermodynamic Apparatus

4,095,648 Shipes, K.V.
1978 June 20,
165/162
042B
Tube Bundles

4,098,332 Bratthall, L.; and Linstrom, B.
1978 July 4,
165/172
042B
Finned Tube Heat Exchanger Construction

4,108,242 Searight, E.F.; and Flanagan, P.
1978 Aug. 22,
165/164
062D
Jet Impingement Heat Exchanger

4,109,709 Honda, T; Takasu, S; and Onuki, Y.
1978 Aug. 29
165/105
085F
Heat Pipes, Process and Apparatus for Manufacturing Same

4,109,710 Forster, S.; and Kleemann, F.
1978 Aug. 29,
165/165
062D
Heat Exchanger

4,109,711 Kleine, C.A.; and Middleton, V.L.
1978 Aug. 29,
165/170
062D
Heat Exchange Panel

4,118,944 Lord, R.G.; Bussjager, R.C.; and Geary, D.F.
1978 Oct. 10,
62/98
043A
High Performance Heat Exchanger

4,120,351 Kleine, C.A.; and Middleton, V.L.
1978 Oct. 17,
165/170
062D
Heat Exchange Panel With Improved Header

4,121,654 Stockman, R.F.
1978 Oct. 24,
165/6
112
Dry Cooling Tower

4,123,837 Horner, I.M.
1978 Nov. 7,
29/157.3R
014C
Heat Transfer Method

4,124,061 Mitchell, R.C. ETAL
1978 Nov. 7,
165/1
082F
Thermal Energy Storage Unit

4,126,177 Smith, R.L.; and Yann, C.C.
1978 Nov. 21,
165/91
112
Dual Scraped Surface Heat Exchanger

4,128,125 Borjesson, L.R.; and Johansson, L.A.
1978,Dec. 5,
165/163
062D
Spiral Heat Exchanger

4,129,181 Janowski, K.R.; Shum, M.S.; and Bradley, S.A.
1978 Dec. 12,
165/133
015C
Heat Transfer Surface

4,130,902 Mackenroth, J.R. III; and Bode, H.B.
1978 Dec. 26,
2/7
081F
Cooling Hatband

4,131,157 Laing, N.
1978 Dec. 26,
165/86
042B
Rotary Heat Exchangers

4,131,159 Long, W.A.
1978 Dec. 26,
165/166
062D
Heat Exchanger

4,133,375 Ducasse, J.C.V.; and Bouvet, J.
1979 Jan. 9,
165/92
112
Vertical Heat Exchanger

4,133,377 Lallee, de.J.; Marie, G; and Moracchioli, R.
1979 Jan. 9,
165/118
062D
Thin-Film Heat Exchanger

4,139,054 Anderson, J.H.
1979 Feb. 13,
165/76
065D
Plate Fin Heat Exchanger

4,141,409 Woodhull, I.D.Jr.; and Liedel, T.H.
1979 Feb. 27,
165/110
045F
Condenser Header Construction

4,141,411 Kalnin, I.M. ETAL
1979 Feb. 27,
165/151
042B
Tubular Heat Exchanger

4,143,710 LaPorte, G.E.; Osterkorn, C.L.; and Marino, S.M.
1979 Mar. 13,
165/182
042B
Heat Transfer Fin Surface

4,144,933 Asselman, G.A.A.; and Castelijns, A.P.J.
1979 Mar 20,
165/124
062E
Heat Exchanger

4,146,090 Nakayama, Y.; and Komana, N.
1979 Mar. 27,
165/166
062D
Plate Type Heat Exchanger

4,148,357 Forster, S.; and Kleemann, M.
1979 April 10,
165/140
062E
Heat Exchanger Matrix for Recuperative Heat Exchange etc.

4,154,293 Fenner, G.W.; and Raqi, E.G.
1979 May 15,
165/133
014A
Enhanced Tube Inner Surface Heat Transfer Device and Method

4,154,293 Penner, G.W.; and Ragi, E.G.
1979 May 15,
165/133
015A
Enhanced Tube Inner Surface Heat Transfer Device and Method

4,154,296 Fijas, D.F.
1979 May 15,
165/179
042A
Inner Finned Heat Exchanger Tube

4,156,459 Kusuda, H.; and Uehara, H.
1979 May 29,
165/167
033D
Plate Type Evaporator

4,159,735 Anderson, J.H.
1979 July 3
165/40
043D
Plate-Fin Heat Exchanger With Controls Therefor

4,159,735 Anderson, J.H.
1979 July 3
165/40
043E
Plate-Fin Heat Exchanger With Controls Therefor

4,159,739 Brothers, W.S.; and Kallfelz, A.J.
1979 July 3
165/133
043C
Heat Transfer Surface and Method of Manufacture

4,162,703 Bosaeus, J.A.
1979 July 31
165/167
062D
Plate-Type Heat Exchanger

4,163,474 MacDonald, R.D.; Rose, R.K.; and Papsdorf
1979 Aug. 7
165/179
042A
Internally Finned Tube

4,163,474 MacDonald, R.D.; Rose, R.K.; and Papsdorf
1979 Aug. 7
165/179
042E
Internally Finned Tube

4,166,498 Fujie, K. ETAL
1979 Sep, 4
165/133
045B
Vapor-Condensing, Heat-Transfer Wall

4,171,015 Bucey, C.W.; Miller, K.J.; and Robinson, R.R.
1979 Oct. 16
165/181
042C
Heat Exchanger Tube and Method of Making Same

4,171,015 Bucey, C.W.; Miller, K.J.; and Robinson, R.R.
1979 Oct. 16
165/181
042E
Heat Exchanger Tube and Method of Making Same

4,176,713 Fisher, H.
1979 Dec. 4
165/166
062D
Plate-Type Heat Exchanger

4,179,911 Saier, M.; Kastner, H-W.; and Klockler, R.
1979 Dec. 25, Wieland-Werke Aktiengesellschaft
72/78
023B
Y and T-Finned Tubes and Methods and Apparatus for Their Making

4,180,129 Sumitomo, H.
1979 Dec. 25, Hisaka Works, Ltd.
165/110
065D
Plate Type Condenser

4,180,897 Chester, D.H.
1980 Jan. 1
29/157.3A
042B
Method of Fabricating Honeycomb Heat Exchanger

4,180,897 Chester, D.H.
1980 Jan. 1,
29/157.3 A
042B
Method of Fabricating Honeycomb Heat Exchanger

4,182,410 Yoshida, K.; Kobayashi, K.; and Sumitomo, H.
1980 Jan 8, Hisaka Works Ltd.
165/110
065D
Plate Type Condenser

4,182,411 Sumitomo, H.; Fukami, K;, Kobayashi, K.; Doi, M., Kawanishi, K. and Yoshida, K.
1980 Jan. 8, Hisaka Works Ltd.
165/110
065D
Plate Type Condenser

4,182,412 Shum, M.S.
1980 Jan. 8, UOP Inc.
165/133
023B
Finned Heat Transfer Tube with Porous Boiling Surface and Method for Producing Same

4,183,403 Nicholson, T.P.
1980 Jan. 15
165/166
062D
Plate Type Heat Exchangers

4,184,540 Myreen, B.
1980 Jan. 22, RA-Shipping Ltd.
165/92
112B
Rotary Heat Exchanger

4,184,542 Sumitomo, H.
1980 Jan. 22, Hisaka Works, Ltd.
165/166
065D
Plate Type Condenser

4,184,544 Ullmer, H.J.
1980 Jan. 22
165/184
041B
Apparatus and Method for Recovering Waste Heat From Flue Gases

4,186,063 Albertson, C.E.; Nichols, G.M.; and Rasmussen, N.
1980 Jan. 29, Borg-Warner Corporation
204/29
013B
Boiling Heat Transfer Surface, Method of Preparing Same and Method of Boiling

4,186,779 Wagner, W.T.
1980 Feb. 5, Dayco Corporation
138/121
022A
Corrugated Metal Tube

4,186,798 Tseluiko, J.I.; Kutsykovich, D.B.; Shabelnikova, L.A., Kholopov, V., Schekin, N.G., Gritsuk, L.D., Katsenelenbogen, L.B.
1980 Feb. 5
165/147
054A
Tubular Cooled Members of Metallurgical Furnace

4,190,105 Dankowski, G.
1980 Feb. 26
165/179
042A
Heat Exchange Tube

4,194,560 Matsuzaki, Y.
1980 Mar. 25, Nihon Radiator Co., Ltd.
165/141
052A
Oil Cooler and Method for Forming It

4,195,688 Fujie, K.; Nakayama, W.; Kuwahara, H.; Daikoku, T.; and Kakizaki, K.
1980 Apr. 1, Hitachi, Ltd.; Hitachi Cable, Ltd.
165/133
025B
Heat-Transfer Wall for Condensation and Method of Manufacturing the Same

4,211,276 Itoh, M.; Takasuna, T.; Ishikawa, Y.; Kimura, H.; and Musoh, M.
1980 Jul. 8, Hitachi, Ltd.
165/1
013E
Method of Making Fin Elements for Heat Exchangers

4,216,575 Carnavos, T. C.; and Golymbieski, W. J.
1980 Aug. 12, Noranda Mines, Ltd.
29/597
042A
Method of Reforming the Fins of a Finned Tube

4,216,825 Sumitomo, H.
1980 Aug. 12, Hisaka Works, Ltd.
165/109 R
013D
Plate Type Evaporator

4,216,826 Fujikake, J.
1980 Aug. 12, Furukawa Metals Co., Ltd.
165/133
023C
Heat Transfer Tube for Use in Boiling Type Heat Exchangers and Method of Producing the Same

4,219,078 Withers, Jr., J.G.
1980 Aug. 26, UOP Inc.
165/133
013F
Heat Transfer Surface for Nucleate Boiling

4,223,539 Webb, R.L.; and Mouqin, L.J.
1980 Sep. 23, The Trane Company
62/476
086C
Apparatus for Absorbing a Vapor in a Liquid and Absorption Refrigeration System Incorporating Same

4,223,723 Hilal, M.A.
1980 Sep. 23, Wisconsin Alumni Research Foundation
165/133
063F
Heat Transfer in Boiling Liquified Gas

4,227,572 Harlan, C. S.
1980 Oct. 14, Seton-Scherr, Inc.
165/184
042A
Finned Tubing

4,228,850 Sumitomo, H.
1980 Oct. 21, Hisaka Works, Ltd.
165/110
065D
Plate Used in Condenser

4,228,852 Togashi, A.
1980 Oct. 21
165/173
022A
Tubular Body

4,230,179 Uehara, H.; and Miyoshi, M.
1980 Oct. 28, Haruo Uehara; Tokyo Shibaura Denki Kabushiki Kaisha
165/113
065D
Plate Type Condensers

4,232,728 Fenner, G.W.; and Raqi, E.G.
1980 Nov. 11, Union Carbide Corporation
165/1
022A
Method for Enhanced Heat Transfer

4,232,728 Fenner, G.W.; and Raqi, E.G.
1980 Nov. 11, Union Carbide Corporation
165/1
025A
Method for Enhanced Heat Transfer

4,236,578 Kreith, F. and Cornelison, R.C.
1980 Dec. 2, Condar, Co.
165/181
041B
Heat Exchange Enhancement Structure

4,237,970 Uehara, H.; and Miyoshi, M.
1980 Dec. 9, Haruo Uehara; Denki Kabushiki Kaisha
165/110
085D
Plate Type Condensers

4,245,695 Fujikake, J.
1981 Jan. 20, Furukawa Metals Co., Ltd.
165/133
025C
Heat Transfer Tube for Condensation and Method for Manufacturing Same

4,245,697 Togashi, A.
1981 Jan. 20
165/179
022A
Tubular Body

4,253,519 Kun, L.C.; and Ragi, E.G.
1981 Mar. 3, Union Carbide Corporation
165/110
035B
Enhancement for Film Condensation Apparatus

4,258,782 Kao, S.S.T.
1981 Mar. 31, Modine Manufacturing Company
165/109 T
042A
Heat Exchanger Having Liquid Turbulator

4,258,783 Albertson, C.E.; Nichols, G.M.; and Rasmussen, J.N.
1981 Mar. 31, Borg-Warner Corporation
165/133
023C
Boiling Heat Transfer Surface, Method of Preparing Same and Method of Boiling

4,269,265 Meyer, R.A.; and Bretl, R.A.
1981 May 26, Modine Manufacturing Company
165/109 T
032A
Tabular Heat Exchanger with Turbulator

4,283,824 Schatz, F.; and Ziemek, G.
1981 Aug. 18, Kabel-und Metallwerke Gutehoffnungshuette AG
29/157.4
022A
Method for Manufacturing Heat Exchanger Tubing

4,284,133 Gianni, S.J.; and Seeley, W.M.
1981 Aug. 18, Dunham-Bush, Inc.
165/133
044A
Concentric Tube Heat Exchange Assembly with Improved Internal Fin Structure

4,285,395 Masutani, K.; Horiguchi, A.; and Sumitomo, H.
1981 Aug 25
165/110
065D
Structure of Fluid Condensing and Heat Conducting surface of Condenser

4,286,366 Vinyard, B.E.
1981 Sep. 1, Phillips Petroleum Company
29/157.4
032C/B
Method for the Construction of a Baffled Heat Exchanger

4,286,655 Trojani, B.L.
1981 Sep. 1
165/179
042A
Finned Tube for Heat Exchangers

4,288,897 Withers, Jr., J.G.
1981 Sep. 15, UOP Inc.
29/157.4
013C
Method of Producing a Nucleate Boiling Surface on a Heat Transfer Member

4,291,758 Fujii, M.; Ogawa, Y.; and Morihiro, Y.
1981 Sep. 29, Mitsubishi Denki Kabushiki Kaisha
165/133
013C
Preparation of Boiling Heat Transfer Surface

4,296,539 Asami, T.
1981 Oct. 27, Kobe Steel, Ltd.
29/157.3 A
042A
Heat Transfer Tubing for Natural Gas Evaporator

4,296,779 Smick, R.H.
1981 Oct. 27,
138/38
032A
Turbulator with Ganged Strips

4,300,629 Hatada, T.; Senshu, T.; Arai, A.; Harada, F.; Matsuzaki, A.; Futawatari, H.; Imaizumi, Y.; and Takeda, S.
1981 Nov. 17, Hitachi, Ltd.
165/151
042B
Cross-Fin Tube Type Heat Exchanger

4,300,630 Trojani, B.L.
1981 Nov. 17
165/181
042B
Finned Metal Tube and Method for Making the Same

4,305,460 Yampolsky, J.S.
1981 Dec. 15, General Atomic Company
165/179
042A
Heat Transfer Tube

4,305,460 Yampolsky, J.S.
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165/179
085C
Heat Transfer Tube

4,306,619 Trojani, B.L.
1981 Dec. 22
165/179
042A
Tube Provided with Inner Fins and Outer Fins or Pins, Particularly for Heat Exchangers, and Method Therefor

4,311,187 Small, W.M.
1982 Jan. 19, Phillips Petroleum Company
165/1
032C
Vortex Generators

4,311,193 Verhaeghe, R.C.; and Huggins, H.D.
1982 Jan. 19, Modine Manufacturing Company
165/149
042B
Serpentine Fin Heat Exchanger

4,313,248 Fujikake, J.
1982 Feb. 2, Fukurawa Metals Co., Ltd.
29/157.3 A
023C
Method of Producing Heat Transfer Tube for Use in Boiling Type Heat Exchangers

4,313,494 Bengtsson, F.
1982 Feb. 2, Carl Johan Lockmans Ingenjorsbyra
165/140
062D
Plate Heat Exchanger

4,314,587 Hackett, C.D.
1982 Feb. 9, Combustion Engineering, Inc.
138/38
024A
Rib Design for Boiler Tubes

4,314,605 Sumitomo, H.; Doi, M.; Kobayashi, K.; Fukami, K.; and Kawanishi, K.
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165/110
085D
Condenser

4,314,606 Muller, W.; Gauer, R.; Walkenhorst, W.; and Wild, G.
1982 Feb. 9, Hoechst Aktiengesellschaft
165/163
062C
Apparatus for a Treatment of Flowing Media Which Causes Heat Exchange and Mixing

4,317,268 Bowden, D.R.; and Novell, B.J.
1982 Mar. 2, Solar Limited, Inc.
29/157.3 AH
042C
Process for Making a Heater Exchanger

4,328,861 Cheong, A.S.; and Beldam, R.P.
1982 May 11, Borg-Warner Corporation
165/151
042B
Louvred Fins for Heat Exchangers

4,330,036 Satoh, Y; and Higo, T.
1982 May 18, Kobe Steel, Ltd.
165/179
045C
Construction of a Heat Transfer Wall and Heat Transfer Pipe and Method of Producing Heat Transfer Pipe

4,330,036 Satoh, Y; and Higo, T.
1982 May 18, Kobe Steel, Ltd.
165/179
022A
Construction of a Heat Transfer Wall and Heat Transfer Pipe and Method of Producing Heat Transfer Pipe

4,332,291 Mulock-Bentley, D.
1982 Jun. 1, D. Mulock-Bentley and Associates
165/76
042B
Heat Exchanger with Slotted Fin Strips

4,332,293 Hiramatsu, M.
1982 Jun. 1, Nippondenso Co., Ltd.
165/153
042B
Corrugated Fin Type Heat Exchanger

4,336,838 Ely, R.J.
1982 Jun. 29,
165/109 T
072A
Heat Exchange Turbulator

4,337,826 Kritzer, R.W.
1982 Jul. 6, Peerless of America, Inc.
165/151
042E
Heat Exchangers and Method of Making Same

4,342,360 Gentry, C.C.
1982 Aug. 3, Phillips Petroleum Co.
165/67
032B
Rod Baffled Heat Exchanger

4,345,644 Dankowski, D.B.
1982 Aug. 24
165/154
042A/C
Oil Cooler

4,346,760 Vidal-Meza, G.D.
1982 Aug. 31, Caterpillar Tractor Co.
165/166
042E
Heat Exchanger Plate Having Distortion Resistant Uniform Pleats

4,347,897 Sumitomo, H.; and Nehara, H.
1982, Sep. 7, Hisaka Works, Ltd.
165/167
152D
Plate Type Heat Exchanger

4,349,068 Coury, G. E.
1982 Sep. 14,
165/1
154A
Method for Improved Heat Transfer

4,351,389 Guarnaschelli, S.
1982 Sep. 28,
165/141
022A
Heat Exchanger Apparatus

4,351,392 Stockman, F. F.
1982 Sep. 28, Combustion Engineering, Inc.
165/186
042A
Heat Exchange Tube with Heat Absorptive Shield

4,352,392 Eastman, G.Y.
1982 Oct. 5, Thermacore, Inc.
165/104.25
013F
Mechanically Assisted Evaporator Surface

4,353,415 Klaschka, J. T.; and Davies, M. J.
1982 Oct. 12, United Kingdom Atomic Energy Authority
165/104.21
084A
Heat Pipes and Thermal Siphons

4,354,550 Modahl, R. J.; and Luckeroth, V. C.
1982 Oct. 19, The Trane Company
165/133
013C
Heat Transfer Surface for Efficient Boiling of Liquid R-11 and Equivalents

4,359,086 Sanborn, D. F.; Holman, J. L. M.; and Ware, C. D.
1982 Nov. 16, The Trane Company
165/133
013C
Heat Exchange Surface with Porous Coating and Subsurface Cavities

4,360,058 Muellejans, H.
1982 Nov. 23, Sueddeutsche Kuehlerfabrik Julius Fr. Behr GmbH & Co.
165/104.21
025A
Process for the Preparation of a Surface of a Metal Wall for the fer of Heat

4,360,059 Funke, K.-H.
1982 Nov. 23, Funke Warmeaustauscher Apparatebau KG
165/160
042C
Tube Type Heat Exchanger

4,365,667 Hatada, T.; Senshu, T.; Arai, A.; Harada, F.; Matsuzaki, A.; atari, H.; Imaizumi, Y.; Takeda, S.
1982 Dec. 28, Hitachi, Ltd.
165/152
032E
Heat Exchanger

4,366,859 Keyes, J.M.
1983 Jan. 4,
165/184
046E
Refractory Heat Exchange Tube

4,367,791 Asami, T.
1983 Jan. 11, Kobe Steel Ltd.
165/109
044A/B
Heat Transfer Tubing for Natural Gas Evaporator

4,368,776 Negita, J.; Yamada, Y.; Kaneko, H.; Ogino, T.
1983 Jan. 18, Nippondenso Co., Ltd.
165/133
042B
Aluminum Heat Exchanger

4,368,777 Grasso, G.
1983 Jan. 18, Centro Ricerche Fiat S.p.A.
165/154
042B
Gas-Liquid Heat Exchanger

4,368,779 Rojey, A.; and Cohen, G.
1983 Jan. 18, Institut Francais du Petrole
165/165
042E
Compact Heat Exchanger

4,369,835 Goudy, P.R., Jr.
1983 Jan. 25, B.J. Landis, K.J. Landis, P.R. Goudy, Jr.
165/154
112A
Thermal Energy Transfer Apparatus and Method

4,369,837 Moranne, J.-P.
1983 Jan. 25, Societe Anonyme des Usines Chausson
165/175
042B
Tube for Tube-Plate Heat Exchangers

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165/175
024B
Tube for Tube-Plate Heat Exchangers

4,369,838 Asanuma, Y.; and Showa, K.
1983 Jan. 25, Aluminum Kabushiki Kaisha Showa
165/185
041E
Device for Releasing Heat

4,373,577 McMillen, R.G.
1983 Feb. 15, International Harvester Co.
165/122
042B
Heat Exchanger Assembly

4,373,578 Saperstein, Z.P.; El-Bourini, R.M.; and Munch, J.E.
1983 Feb. 15, Modine Manufacturing Company
165/141
042B
Radiator with Heat Exchanger

4,374,542 Bradley, J.C.
1983 Feb. 22,
165/166
042F
Undulating Prismoid Modules

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1983 Feb. 22,
165/166
046F
Undulating Prismoid Modules

4,375,832 Asselman, G.A.; Casteligns, A.P.J.; and Van Mensvoort, A.J.
1983 Mar. 8, U.S. Philips Corp.
165/152
042B
Tube and Fin Radiator

LIST BY FIRST INVENTOR

PAGES 87 to 88

WERE INTENTIONALLY

LEFT BLANK

3,022,049 Abbott, R.W.
1962 Feb. 20,
257/262.13
042B
Heat Exchange Tubing

4,018,264 Albertson, C.E.
1977 April 19,
165/1
015C
Boiling Heat Transfer Surface And Method

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1981 Mar. 31, Borg-Warner Corporation
165/133
023C
Boiling Heat Transfer Surface, Method of Preparing Same and Method of Boiling

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204/29
013B
Boiling Heat Transfer Surface, Method of Preparing Same and Method of Boiling

3,261,905 Allen, B.F.
1966 July 19, General Electric Company
174/15
153F
Stationary Induction Apparatus Cooling System

3,128,821 Andersen, R. C.
1964 Apr. 14, Flexonics Corp.
153/71
022A
Corrugator for Metal Tubing

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153/71
042C
Corrugator for Metal Tubing

4,139,054 Anderson, J.H.
1979 Feb. 13,
165/76
065D
Plate Fin Heat Exchanger

4,159,735 Anderson, J.H.
1979 July 3
165/40
043D
Plate-Fin Heat Exchanger With Controls Therefor

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1979 July 3
165/40
043E
Plate-Fin Heat Exchanger With Controls Therefor

3,724,094 Appel, D.W.; and Hong, S.H.
1973 Apr. 3, Kimberly-Clark Corp.
34/124
112B
Rotary Drying Drum

2,369,094 Arvins, N.A.; and Arvintz, A.A.
1944 Oct. 10,
257/233
072F
Heat Exchanger

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29/157.3 A
042A
Heat Transfer Tubing for Natural Gas Evaporator

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1983 Jan. 11, Kobe Steel Ltd.
165/109
044A/B
Heat Transfer Tubing for Natural Gas Evaporator

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1983 Jan. 25, Aluminum Kabushiki Kaisha Showa
165/185
041E
Device for Releasing Heat

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165/152
042B
Tube and Fin Radiator

4,144,933 Asselman, G.A.A.; and Castelijns, A.P.J.
1979 Mar 20,
165/124
062E
Heat Exchanger

3,731,732 Awe, R.C.; Burton, J.C.; and Blank, T.G.
1973 May 8,
165/181
042B
Tube And Fin Heat Exchanger

2,279,548 Bailey, E.G.
1942 April 14,
122/235
023A
Liquid Vaporizing Tube

4,016,928 Bartels, E.L.; and Fleming, R.B.
1977 April 12,
165/141
062D
Heat Exchanger Core Having Expanded Metal Heat Transfer Surfaces

3,887,004 Beck, T.A.
1975 June 3,
165/179
042A
Heat Exchange Apparatus

1,708,600 Beckman, J.H.
1929 April 9,
153F
Cooler

4,313,494 Benqtsson, F.
1982 Feb. 2, Carl Johan Lockmans Ingenjorsbyra
165/148
062D
Plate Heat Exchanger

2,970,669 Berqson, G.
1961 Feb. 7,
183/2
085A
Condensing Filter

3,235,004 Beurtheret, C.
1966 Feb. 15, Compagnie Francaise Thomson-Houston
165/185
043F
Heat Dissipating Structure

2,969,957 Beurtheret, C. A. E.
1961 Jan. 31, Compagnie Francaise Thomson-Houston
257/250
043F
Electric Discharge Device Cooling Systems

3,046,428 Beurtheret, C. A. E.
1962 July 24, Compagnie Francaise Thomson-Houston
313/12
043F
High Frequency Energy Interchange Device

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313/12
043F
High Frequency Energy Interchange Device

3,384,160 Beurtheret, C.A.
1968 May 21, Compagnie Francaise Thomson Houston-Hotchkiss Brandt
165/74
043F
Non-Isothermal Evaporation Type Heat Transfer Apparatus

3,299,949 Beurtheret, C.A.E.
1967 Jan. 24,
165/185
043C
Device For Evaporative Cooling Of Bodies And Power Vacuum etc.

2,935,305 Beurtheret, C.A.E.
1960 May 3,
257/250
142F
Electric Discharge Device Cooling System

3,055,643 Beurtheret, C.A.E.
1962 Sept. 25,
257/250
073A
Heat Exchangers

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1967 Feb. 28, Compagnie Francise Thomson Houston-Hotchkiss Brandt
165/105
043F
Electron Discharge Tube Having Improved Cooling Means Therefor

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1968 Feb. 6, Compagnie Francaise Thomson Houston-Hotchkiss Brandt
165/185
043F
Anisotherm Evaporation Heat-Transfer Structure

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165/1
043E
Heat Exchanger

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1960 May 3, General Electric Company
257/250
043F
Vapor Cooling Apparatus for Electric Discharge Devices

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123/8
043F
Two-Stage Cooling System for Heat Machine Components

3,521,705 Beutheret, C. A.; and Douguet, E. J.
1970 July 28, Compagnie Francaise Thomson Houston-Hotchkiss Brandt
165/74
023C
Heat Exchange Structure and Electron Tube Including Such Exchange Structure

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1974 Oct. 29,
165/86
112
Rotatable Finned Heat Exchanger Device

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1960 Aug. 2,
62/40
045F
H-X For Seperating Out Constituents From A Gas By Cooling

3,735,175 Blomgren, O.C. Jr.
1973 May 22,
313/60
141F
Method For Removing Heat From Within A Vacuum And From etc.

3,224,497 Blomgren, O.C. Sr. ETAL
1965 Dec. 21,
165/2
142F
Method And Apparatus For Lowering The Temperature Of A Heated Body

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1965 Dec. 21,
165/2
141F
Method And Apparatus For Lowering The Temperature Of A Heated Body

3,224,485 Blomgren, O.C. Sr. ETAL
1965 Dec. 21,
158/1
141A
Heat Control Device And Method

3,670,606 Blomgren, O.C. Sr.; and Blomgren, O.C. Jr.
1972 June 20,
82/1 C
141F
Method & Apparatus For Cooling Workpiece And/Or The Cutting etc.

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165/1
142F
Cooling Apparatus And Method For Heat Exchangers

2,985,434 Boring, S.A.;Speca, E.J.; and Zierak, S.J.
1961 May 23,
257/245
042D
Regenerator

4,128,125 Borjesson, L.R.; and Johansson, L.A.
1978,Dec. 5,
165/163
062D
Spiral Heat Exchanger

4,162,703 Bosaeus, J.A.
1979 July 31
165/167
062D
Plate-Type Heat Exchanger

3,752,228 Bosse, R.C.
1973 Aug. 14,
165/184
042B
I-Type Segmented Finned Tube

3,156,455 Boulet, C.
1964 Nov. 10, Holo-Flite Intl. Inc.
263/21
112B
Methods of Effecting Heat Exchange and Heat Transfer Devices Therefor

4,317,268 Bowden, D.R.; and Novell, B.J.
1982 Mar. 2, Solar Limited, Inc.
29/157.3 AH
042C
Process for Making a Heater Exchanger

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1983 Feb. 22,
165/166
042F
Undulating Prismoid Modules

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165/166
046F
Undulating Prismoid Modules

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1978 July 4,
165/172
042B
Finned Tube Heat Exchanger Construction

3,605,872 Brault, J.
1971 Sept. 20,
165/1
072A
Method Causing Liquid To Flow In Stream Of Annular Cross Section

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1979 July 3
165/133
043C
Heat Transfer Surface and Method of Manufacture

3,613,779 Brown, C.E.
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165/133
085C
Apparatus For Obtaining High Heat Transfer In Falling Water Film

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165/181
042C
Heat Exchanger Tube and Method of Making Same

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165/181
042E
Heat Exchanger Tube and Method of Making Same

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1960 Feb. 2,
117/49
015B
Method Of Applying A Plastic Coating

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72/299
062A
Method and Machine for Spirally Corrugating Tubes

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142F
Heat Transfer

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1971 July 27,
165/181
042B
Modular Units And Use Thereof In Heat Exchangers

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1975 March 18,
138/38
043A
Heat Exchange Apparatus

4,040,479 Campbell, B.J.; and Rieger, K.R.
1977 Aug. 9,
165/133
043C
Finned Tube Having Enhanced Nucleate Boiling Surface

4,216,575 Carnavos, T. C.; and Golymbieski, W. J.
1980 Aug. 12, Noranda Mines, Ltd.
29/597
042A
Method of Reforming the Fins of a Finned Tube

2,983,115 Caswell, H.E.
1961 May 9,
62/285
045C
Heat Transfer Device With Condensate Drainage Means

3,783,938 Chartet, A.
1974 Jan. 8,
165/166
072A
Disturbing Device And Heat Exchanger Embodying The Same

4,072,182 Cheng, D.Y.
1978 Feb. 7,
165/1
112
Pressure Staged Heat Exchanger

4,328,861 Cheong, A.S.; and Beldam, R.P.
1982 May 11, Borg-Warner Corporation
165/151
042B
Louvred Fins for Heat Exchangers

4,180,897 Chester, D.H.
1980 Jan. 1
29/157.3A
042E
Method of Fabricating Honeycomb Heat Exchanger

4,180,897 Chester, D.H.
1980 Jan. 1,
29/157.3 A
042B
Method of Fabricating Honeycomb Heat Exchanger

2,731,241 Christian, J. D.
1956 Jan 17,
257/79
112C
Heat Exchange Device

2,733,898 Christian, J. D.
1956 Feb. 7,
257/101
112C
Hollow Screw Conveyor Flight

2,753,159 Christian, J. D.
1956 July 3, Holo-Flite Inc.
257/79
112C
Heat Transfer Device

2,916,807 Christian, J. D.
1959 Dec. 15,
29/156.8
112C
Heat Exchange Equipment

2,917,284 Christian, J. D.
1959 Dec. 15,
257/112
112C
Heat Exchange Apparatus

4,050,507 Chu, R.C.; and Moran, K.P.
1977 Sept. 27,
165/1
023F
Method For Customizing Nucleate Boiling H.T. From Electronic etc.

3,448,791 Clark, J.
1969 June 10,
165/1
142F
Methods And Apparatuses For Energy Transfer

2,245,069 Clark, W.R.
1941 June 10,
257/262
042B
Heat Transfer Unit

3,071,159 Coraggioso, C.B.
1963 Jan. 1,
138/38
072A
Heat Exchange Tube

2,958,021 Cornelison, B.; and Wolff, E.A. Jr.
1960 Oct. 25,
317/234
043A
Cooling Arrangement For Transistors

4,349,068 Coury, G. E.
1982 Sep. 14,
165/1
154A
Method for Improved Heat Transfer

3,608,629 Cowans, K.W.
1971 Sept. 28,
165/165
062D
Flow Compensator For Exchanger Apparatus

3,213,525 Creighton, W.M.; Evans, S.O.; and McMurdy, A.E.
1965 Oct. 26,
29/157.3
062A
Method of Forming An Internal Rib In The Bore Of A Tube

4,031,602 Cunningham, J.L.; and Campbell, B.J.
1977 June 28,
29/157.3AH
042A
Method Of Making Heat Transfer Tube

4,031,602 Cunningham, J.L.; and Campbell, B.J.
1977 June 28,
29/157.3AH
042A
Method Of Making Heat Transfer Tube

3,730,229 D'Onofrio, M. L.
1973 May 1, Turbotec, Inc.
138/114
062A
Tubing Unit with Helically Corrugated Tube and Method for Making Same

3,990,862 Dahl, M.M.; and Erb, L.D.
1976 Nov. 9,
29/191.2
013F
Liquid Heat Exchanger Interface And Method

4,093,755 Dahl, M.M.; and Erb, L.D.
1978, June 6, The Gates Rubber Company
427/299
013B
Method for Making a Liquid Heat Exchanger Coating

3,370,644 Daily, W.B.; and Speca, E.J.
1968 Feb. 27,
165/1
142A
Method Of Increasing The Rate Of Heat Transfer

3,397,440 Dalin, D.
1968 Aug. 20,
29/157.3
022C
Method Of Making Heat Exchanger Having Extended Surface

4,345,644 Dankowski, D.B.
1982 Aug. 24
165/154
042A/C
Oil Cooler

4,190,105 Dankowski, G.
1980 Feb. 26
165/179
042A
Heat Exchange Tube

3,827,343 Darm, W.J.
1974 Aug. 6,
98/115
062D
Grease Collecting Heat Exchanger Installation

3,995,688 Darm, W.J.
1976 Dec. 7,
165/165
062D
Air To Air Heat Exchanger

3,759,323 Dawson, H.J. ETAL
1973 Sept. 18,
165/166
062D
C-Flow Stacked Plate Heat Exchanger

3,878,885 Deronzier, J.C. ETAL
1975 April 22,
165/1
105A
Method For Causing Condensation In Drops On H-X Tubes

3,878,885 Deronzier, J.C. ETAL
1975 April 22,
165/1
105B
Method For Causing Condensation In Drops On Heat Exchanger Tubes

3,244,601 Diedrich, G.E.
1966 April 5,
202/236
025C
Fluted Tubular Distillation Apparatus

3,207,216 Donaldson, D.M.
1965 Sept. 21,
165/148
062D
Heat Exchanger

4,002,201 Donaldson, D.M.
1977 Jan. 11,
165/140
062D
Multiple Fluid Stacked Plate Heat Exchanger

2,895,508 Drake, C.E.
1959 July 21,
138/38
042A
Heat Exchanger Conduit

3,636,982 Drake, C.E.
1972 Jan. 25,
138/38
042A
Internally Finned Tube And Method Of Forming Same

4,133,375 Ducasse, J.C.V.; and Bouvet, J.
1979 Jan. 9,
165/92
112
Vertical Heat Exchanger

3,687,434 Dyskin, E.M. ETAL
1972 Aug. 29,
266/24
113A
Hollow Tyre Of Rotary Furnaces & Method Of Equalizing Tyre Temp.

4,352,392 Eastman, G.Y.
1982 Oct. 5, Thermacore, Inc.
165/104.25
013F
Mechanically Assisted Evaporator Surface

3,547,185 Eissenberg, D.M.
1970 Dec. 15,
165/1
105C
Method For Promoting Dropwise Condensation On Copper etc.

2,978,797 Ekelund, A.E.
1961 April 11,
29/157.3
042C
Tubular Finned Metal Section And Manufacture Thereof

4,336,838 Ely, R.J.
1982 Jun. 29,
165/109 T
072A
Heat Exchange Turbulator

3,298,427 Erb, R.A.
1967 Jan. 17,
165/1
015F
Method And Apparatus For Dropwise Condensation

3,466,189 Erb, R.A.
1969 Sept. 9,
117/132
015F
Method For Improving Heat Transfer In Condensers

2,813,701 Fenger, C.
1957 Nov. 19,
257/245
045E
Cross Flow Heat Exchanger

4,154,293 Fenner, G.W.; and Ragi, E.G.
1979 May 15,
165/133
014A
Enhanced Tube Inner Surface Heat Transfer Device and Method

4,154,293 Fenner, G.W.; and Ragi, E.G.
1979 May 15,
165/133
015A
Enhanced Tube Inner Surface Heat Transfer Device and Method

4,232,728 Fenner, G.W.; and Ragi, E.G.
1980 Nov. 11, Union Carbide Corporation
165/1
022A
Method for Enhanced Heat Transfer

4,232,728 Fenner, G.W.; and Ragi, E.G.
1980 Nov. 11, Union Carbide Corporation
165/1
025A
Method for Enhanced Heat Transfer

4,154,296 Fijas, D.F.
1979 May 15,
165/179
042A
Inner Finned Heat Exchanger Tube

3,840,069 Fischer, W.; and Gammel, G.
1974 Oct. 8,
165/105
084A
Heat Pipe With A Sintered Capillary Structure

4,176,713 Fisher, H.
1979 Dec. 4
165/166
062D
Plate-Type Heat Exchanger

3,789,915 Ford, J.A.
1974 Feb. 5,
165/1
025C
Process For Improving H.T. Efficiency And Improved H.T. System

3,850,227 Ford, J.A.
1974 Nov. 26,
165/1
022C
Process For Improving Heat Transfer Efficiency etc.

3,612,175 Ford, J.A.; and Wolfe, W. Jr.
1971 Oct. 12,
165/179
022C
Corrugated Metal Tubing

1,680,145 Forssblad, N.R.
1928 Aug. 7,
022D
Heat Exchanger

1,680,145 Forssblad, N.R.
1928 Aug. 7,
022F
Heat Exchanger

4,109,710 Forster, S.; and Kleemann, F.
1978 Aug. 29,
165/165
062D
Heat Exchanger

4,148,357 Forster, S.; and Kleemann, M.
1979 April 10,
165/140
062E
Heat Exchanger Matrix for Recuperative Heat Exchange etc.

3,850,234 Fowler, G.
1974 Nov. 26,
165/153
042D
Heat Exchangers

3,117,625 Fraenkel, S.J.
1964 Jan. 14, Stanray Corp.
165/185
042F
Filling Material for Heat Exchangers

3,422,518 French, F.W.
1969 Jan. 21,
29/157.3
042A
Method Of Reforming Tubular Metal Blanks Into Inner Finned Tubes

3,622,403 French, F.W.
1971 Nov. 23,
148/11.5
022A
Production Of Metal Tubing With Rough Inner Surfaces

3,662,582 French, F.W.
1972 May 16,
72/367
042A
Heat-Exchange Tubing And Method Of Making It

3,750,709 French, F.W.
1973 Aug. 7,
138/38
042A
Heat Exchanger Tube And Method Of Making It

3,776,018 French, F.W.
1973 Dec. 4,
72/367
042A
Tubing With Inner Baffle Fins And Method Of Producing It

4,044,797 Fujie, K. ETAL
1977 Aug. 30,
138/38
023A
Heat Transfer Pipe

4,060,125 Fujie, K. ETAL
1977 Nov. 29,
165/133
013C
Heat Transfer Wall For Boiling Liquids

4,166,498 Fujie, K. ETAL
1979 Sep, 4
165/133
045B
Vapor-Condensing, Heat-Transfer Wall

4,195,688 Fujie, K.; Nakayama, W.; Kuwahara, H.; Daikoku, T.; and Kakizaki, K.
1980 Apr. 1, Hitachi, Ltd.; Hitachi Cable, Ltd.
165/133
025B
Heat-Transfer Wall for Condensation and Method of Manufacturing the Same

4,291,758 Fujii, M.; Ogawa, Y.; and Morihiro, Y.
1981 Sep. 29, Mitsubishi Denki Kabushiki Kaisha
165/133
013C
Preparation of Boiling Heat Transfer Surface

4,216,826 Fujikake, J.
1980 Aug. 12, Furukawa Metals Co., Ltd.
165/133
023C
Heat Transfer Tube for Use in Boiling Type Heat Exchangers and Method of Producing the Same

4,245,695 Fujikake, J.
1981 Jan. 20, Furukawa Metals Co., Ltd.
165/133
025C
Heat Transfer Tube for Condensation and Method for Manufacturing Same

4,313,248 Fujikake, J.
1982 Feb. 2, Fukurawa Metals Co., Ltd.
29/157.3 A
023C
Method of Producing Heat Transfer Tube for Use in Boiling Type Heat Exchangers

4,360,059 Funke, K.-H.
1982 Nov. 23, Funke Warmeaustauscher Apparatebau KG
165/160
042C
Tube Type Heat Exchanger

3,301,314 Gaertner, R.F.
1967 Jan. 31,
165/1
015F
Method And Means For Increasing The H.T. Coefficient etc.

2,950,604 Gambill, W.R.; and Greene, N.D.
1960 Aug. 30,
62/5
074A
Heat Transfer Method

2,517,654 Gaugler, R.S.
1950 Aug. 8,
261/99
073F
Refrigerating Apparatus

2,517,654 Gaugler, R.S.
1950 Aug. 8,
261/99
083F
Refrigerating Apparatus

2,565,221 Gaugler, R.S.
1951 Aug. 21,
261/104
023A
Refrigerating Apparatus

4,342,360 Gentry, C.C.
1982 Aug. 3, Phillips Petroleum Co.
165/67
032B
Rod Baffled Heat Exchanger

3,856,079 Geppelt, E.W.
1974 Dec. 24,
165/184
042C
Finned Tube Heat Exchange Conductor

4,284,133 Gianni, S.J.; and Seeley, W.M.
1981 Aug. 18, Dunham-Bush, Inc.
165/133
044A
Concentric Tube Heat Exchange Assembly with Improved Internal Fin Structure

2,529,013 Gloyer, W.
1950 Nov. 7,
257/245
032D
Heat Exchanger

3,330,336 Gobel, G.
1967 July 11,
165/160
032C
Heat Exchanger Tubes With Longitudinal Ribs

2,432,308 Goodyer, H.J.
1947 Dec. 9,
210/57
042A
Conduit Having Annular Ribs, A Sump, And Sediment Directing Means

4,369,835 Goudy, P.R., Jr.
1983 Jan. 25, B.J. Landis, K.J. Landis, P.R. Goudy, Jr.
165/154
112A
Thermal Energy Transfer Apparatus and Method

3,981,356 Granetzke, D.C.
1976 Sept. 21,
165/179
032A
Heat Exchanger

3,821,018 Grant, A.C.
1974 June 28,
117/94
015C
Porous Metallic Layer Formation

4,064,914 Grant, A.C.
1977 Dec. 27,
138/142
015C
Porous Metallic Layer And Formation

4,368,777 Grasso, G.
1983 Jan. 18, Centro Ricerche Fiat S.p.A.
165/154
042B
Gas-Liquid Heat Exchanger

2,790,310 Green, F.H.
1957 April 30,
62/136
152
Axial Flow Vortex Tube Mechanism

3,865,184 Grover, G.M.
1975 Feb. 11,
165/105
022A
Heat Pipe And Method And Apparatus For Fabricating Same

3,229,759 Grover, G.M.
1966 Jan. 18,
165/105
015F
Evaporation-Condensation Heat Transfer Device

3,229,759 Grover, G.M.
1966 Jan. 18,
165/105
083F
Evaporation-Condensation Heat Transfer Device

3,229,759 Grover, G.M.
1966 Jan. 18,
165/105
085F
Evaporation-Condensation Heat Transfer Device

4,351,389 Guarnaschelli, S.
1982 Sep. 28,
165/141
022A
Heat Exchanger Apparatus

3,438,433 Gunter, A.Y.
1969 April 15, Hudson Engineering
165/151
042B
Plate Fins

3,033,536 Guszmann, M.
1962 May 8,
257/262.16
042B
Radiator System

4,086,959 Habdas, E.P.
1978 May 2,
165/155
042C
Automotive Oil Cooler

4,314,587 Hackett, C.D.
1982 Feb. 9, Combustion Engineering, Inc.
138/38
024A
Rib Design for Boiler Tubes

3,247,583 Hansson, A.; and Brick, R.M.
1966 Apr. 26, Continental Can Company, Inc.
29/157.3
032F
Production of Externally Finned Sheet Stock

4,227,572 Harlan, C. S.
1980 Oct. 14, Seton-Scherr, Inc.
165/184
042A
Finned Tubing

4,029,146 Hart, W.F.; and Koenig, R.A.
1977 June 14,
165/166
042E
Corrugated Sheet Heat Exchanger

3,777,343 Hartford, M. L. D.
1973 Dec. 11, Spiral Tubing Corp.
29/157.3 R
062A
Method for Forming a Helically Corrugated Concentric Tubing Unit

3,363,682 Hartley, D.E.
1968 Jan. 16,
165/181
042E
Heat Exchangers Having Vortex Producing Vanes

4,365,667 Hatada, T.; Senshu, T.; Arai, A.; Harada, F.; Matsuzaki, A.; atari, H.; Imaizumi, Y.; Takeda, S.
1982 Dec. 28, Hitachi, Ltd.
165/152
032E
Heat Exchanger

4,300,629 Hatada, T.; Senshu, T.; Arai, A.; Harada, F.; Matsuzaki, A.; Futawatari, H.; Imaizumi, Y.; and Takeda, S.
1981 Nov. 17, Hitachi, Ltd.
165/151
042B
Cross-Fin Tube Type Heat Exchanger

3,089,318 Hebeler, H.K.
1963 May 14,
62/467
043F
Hypersonic Cooling System

3,621,905 Hedstrom, B.
1971 Nov. 23,
165/1
094A
Method Of Improving The H.T. In A Tube Of An Evaporrator etc.

3,273,599 Heeren, H.
1966 Sept. 20,
138/38
042A
Internally Finned Condenser Tube

3,273,599 Heeren, H.
1966 Sep. 20
138/38
045A
Internally Finned Condenser Tube

3,983,935 Henrion, C.E.
1976 Oct. 5,
165/166
042B
Heat Exchanger

4,223,723 Hilal, M.A.
1980 Sep. 23, Wisconsin Alumni Research Foundation
165/133
063F
Heat Transfer in Boiling Liquified Gas

2,960,114 Hinde, J.N.
1960 Nov. 15,
138/38
043A
Innerfinned Heat Transfer Tubes

4,332,293 Hiramatsu, M.
1982 Jun. 1, Nippondenso Co., Ltd.
165/153
042B
Corrugated Fin Type Heat Exchanger

2,892,618 Holm, S.
1959 June 30,
257/245
042E
H-X And Cores And Extended Surface Elements Therefor

4,109,709 Honda, I; Takasu, S; and Onuki, Y.
1978 Aug. 29
165/105
085F
Heat Pipes, Process and Apparatus for Manufacturing Same

4,123,837 Horner, I.M.
1978 Nov. 7,
29/157.3R
014C
Heat Transfer Method

2,995,344 Hryniszak, W.
1961 Aug. 8,
257/245
062D
Plate Type Heat Exchanger

3,590,917 Huber, J.; and Poth, L.
1971 July 6,
165/167
062D
Plate Type Heat Exchanger

2,905,447 Huet, A.
1959 Sept. 22,
257/262.14
042C
Tubular Heat Exchanger

2,998,228 Huet, A.
1961 Aug. 29,
257/262.18
042C
Surface Heat Exchangers

3,111,168 Huet, A.
1963 Nov. 19,
165/165
042C
Heat Exchangers

3,154,141 Huet, A.
1964 Oct. 27,
165/133
022C
Roughened Heat Exchanger Tube

3,596,495 Huggins, H.D.
1971 Aug. 3,
72/367
042A
Heat Transfer Device And Method Of Making

3,603,384 Huggins, H.D.; and Dudley, C.J.
1971 Sept. 7,
165/181
042B
Expandable Tube And Heat Exchanger

3,202,210 Hughes, R.W.
1965 Aug. 24,
165/154
032C
Heat Exchanger

3,207,209 Hummel, R.L.
1965 Sept. 21,
165/1
013F
Means For Increasing The H.T. Coeficient Between A Wall And etc.

3,015,355 Humphrey, A.H.
1962 Jan. 2, General Gas Light Company
153/78
022A
Method for Forming Spirally Ribbed Tubing

2,729,266 Humphrey, R. P.
1956 Jan. 3; General Gas Light Company
153/71
062A
Apparatus and Method for Making Spirally Corrugated Metal Tubes

2,610,835 Hytte, R.P.L.
1952 Sept. 16,
257/245
062D
Plate Heat Exchanger

2,623,736 Hytte, R.P.L.
1952 Dec. 30,
257/245
062D
Plate Type Pasteurizer

3,825,064 Inoue, K.
1974 July 23,
165/179
015C
Heat Exchanger

4,211,276 Itoh, M.; Takasuna, T.; Ishikawa, Y.; Kimura, H.; and Musoh, M.
1980 Jul. 8, Hitachi, Ltd.
165/1
013E
Method of Making Fin Elements for Heat Exchangers

3,931,854 Ivakhnenko, V.V. ETAL
1976 Jan. 13,
165/166
062D
Plate Type Heat-Exchange Apparatus

3,289,756 Jaeger, U.R.
1966 Dec. 6, Olin Mathieson Chemical Corporation
165/155
042C
Heat Exchanger

4,129,181 Janowski, K.R.; Shum, M.S.; and Bradley, S.A.
1978 Dec. 12,
165/133
015C
Heat Transfer Surface

2,617,634 Jendrassik, G.
1952 Nov. 11,
257/245
062D
Heat Exchanger

2,952,444 Jenssen, S.K.
1960 Sept. 13,
257/245
062D
Heat Exchangers Of The Plate Type

3,705,618 Jouet, E.; and Rebuffe, P.
1972 Dec. 12,
165/166
022F
Heat Exchanger

2,604,936 Kaehni, W.L.; and Kaehni, F.J.
1952 July 29,
158/113
141F
Method And Apparatus For Controlling the Generation Of Heat

2,605,377 Kaehni, W.L.; and Kaehni, F.J.
1952 July 29,
219/19
142A
Heat Exchange Method And Apparatus

3,906,604 Kakizaki, K.; and Suzumura, T.
1975 Sept. 23,
29/157.3A
023F
Method For Forming Heat Transmissive Wall Surface

4,141,411 Kalnin, I.M. ETAL
1979 Feb. 27,
165/151
042B
Tubular Heat Exchanger

3,650,321 Kaltz, K.L.
1972 March 21,
165/106
062D
Sheet Metal Radiator Assembly

4,094,170 Kantor, F.W.
1978 June 13,
62/499
112
Rotary Thermodynamic Apparatus

4,258,782 Kao, S.S.T.
1981 Mar. 31, Modine Manufacturing Company
165/109 T
042A
Heat Exchanger Having Liquid Turbulator

3,886,976 Kardas, A.; Larson, D.H.; and Nesbitt, J.D.
1975 June 3,
138/38
052A
Recuperator Having A Reradiant Insert

3,221,399 Karmazin, J.
1965 Dec. 7,
29/157.3
042B
Method Of Manufacturing Heat Exchanger

3,311,165 Karmazin, J.
1967 March 28,
165/109
062D
Heat Exchanger

3,368,610 Kartluke, H.; and Boyd, C.A.
1968 Feb. 13,
165/1
133F
Superheating Prevention And Boiling Control

3,175,960 Kassat, H.
1965 March 30,
202/189
045B
Air Cooled Condenser For Distilling Apparatus

1,770,208 Kemnal, J.
1930 July 8,
072A
Air Heater

2,439,775 Kennedy, W.W.
1948 April 13,
257/259
112
Heat Exchanger

3,604,504 Kessler, S.W. Jr.; and Hess, J.L.
1971 Sept. 14,
165/105
083A
Flexible Heat Pipe

3,267,564 Keyes, J.M.
1966 Aug. 23,
29/157.3
042A
Method Of Producing Duplex Internally Finned Tube Units

4,366,859 Keyes, J.M.
1983 Jan. 4,
165/184
046E
Refractory Heat Exchange Tube

3,696,863 Kim, S.C.
1972 Oct. 10,
165/179
042A
Inner-Outer Finned Heat Transfer Tubes

4,353,415 Klaschka, J. T.; and Davies, M. J.
1982 Oct. 12, United Kingdom Atomic Energy Authority
165/104.21
084A
Heat Pipes and Thermal Siphons

4,109,711 Kleine, C.A.; and Middleton, V.L.
1978 Aug. 29,
165/170
062D
Heat Exchange Panel

4,120,351 Kleine, C.A.; and Middleton, V.L.
1978 Oct. 17,
165/170
062D
Heat Exchange Panel With Improved Header

3,870,081 Kleppe, B.; and Torgersen, O.
1975 March 11,
138/38
072A
Heat Exchange Conduit

3,602,027 Klug, W.A.; and Ware, C.D.
1971 Aug. 31, The Trane Company
72/90
023B
Simultaneous Finning and Reforming of Tubular Heat Transfer Surface

3,602,027 Klug, W.A.; and Ware, C.D.
1971 Aug. 31, The Trane Company
72/98
042C
Simultaneous Finning and Reforming of Tubular Heat Transfer Surface

3,088,494 Koch, P.H.; Pirsh, E.A.; and Swenson, H.S.
1963 May 7,
138/37
043A
Ribbed Vapor Generating Tubes

3,862,661 Kovalenko, L.M. ETAL
1975 Jan. 28,
165/166
062D
Corrugated Plate For H-X And H-X With Said Etc.

3,174,319 Koyama, S.; Shida, J.; and Nakayama, K.
1965 March 23,
72/96
042B
Method And Apparatus For Manufacturing Integrally Finned Tubing

4,236,578 Kreith, F. and Cornelison, R.C.
1980 Dec. 2, Condar, Co.
165/181
041B
Heat Exchange Enhancement Structure

2,247,243 Kritzer, R. W.
1941 June 24, Thermek Corp.
29/157.3
042B
Heat Exchange Element and Method of Making the Same

2,247,243 Kritzer, R.W.
1941 June 24
29/157.3
042C
Heat Exchange Element and Method of Making the Same

3,202,212 Kritzer, R.W.
1965 Aug. 24,
165/179
042B
Heat Transfer Element

3,229,722 Kritzer, R.W.
1966 Jan. 18,
138/39
042A
Heat Exchange Element With Internal Flow Diverters

3,360,040 Kritzer, R.W.
1967 Dec. 26,
165/181
042B
Heat Exchanger Elements

3,540,530 Kritzer, R.W.
1970 Nov. 17,
165/146
042B
Graduated Heat Exchanger Fins

4,337,826 Kritzer, R.W.
1982 Jul. 6, Peerless of America, Inc.
165/151
042E
Heat Exchangers and Method of Making Same

2,394,698 Kuenhold, O.J. Sr.
1946 Feb. 12,
261/104
015F
Evaporator

3,741,285 Kuetho, A.M.
1973 June 26,
165/1
032D
Boundary Layer Control of Flow Separation and Heat Exchange

3,757,856 Kun, L.C.
1973 Sept. 11,
165/166
062D
Primary Surface Heat Exchanger And Manufacture Thereof

3,810,509 Kun, L.C.
1974 May 14, Union Carbide Corp.
165/148
042B
Cross Flow Heat Exchanger

3,845,814 Kun, L.C.
1974 Nov. 5, Union Carbide Corp.
165/148
042B
Finned Primary Surface Heat Exchanger

3,454,081 Kun, L.C.; and Czikk, A.M.
1969 July 8,
165/133
023A
Surface For Boiling Liquids

4,253,519 Kun, L.C.; and Ragi, E.G.
1981 Mar. 3, Union Carbide Corporation
165/110
035B
Enhancement for Film Condensation Apparatus

4,156,459 Kusuda, H.; and Uehara, H.
1979 May 29,
165/167
033D
Plate Type Evaporator

3,771,589 Lage, J.R.
1973 Nov. 13,
165/1
032A
Method And Apparatus For Improved Transfer Of Heat

3,347,059 Laing, N.
1967 Oct. 17,
62/325
112
Heat Pump

4,131,157 Laing, N.
1978 Dec. 26,
165/86
042B
Rotary Heat Exchangers

4,133,377 Lallee, de.J.; Marie, G; and Moracchioli, R.
1979 Jan. 9,
165/118
062D
Thin-Film Heat Exchanger

4,143,710 LaPorte, G.E.; Osterkorn, C.L.; and Marino, S.M.
1979 Mar. 13,
165/182
042B
Heat Transfer Fin Surface

2,241,209 Lea, E.S.
1941 May 6,
257/236
045C
Finned Condenser Tube

3,528,494 Leyedahl, W.J.
1970 Sept. 15,
165/105
045A
Heat Pipe For Low Thermal Conductivity Working Fluids

4,065,264 Lewin, J.E.
1977 Dec 27,
23/258.5BH
042C
Blood Oxygenator With Integral H-X For Regulating etc.

3,885,936 Limebeer, G.J.N.
1975 May 27,
62/304
042B
Heat Exchangers

3,532,161 Lockel, F.A.
1970 Oct. 6,
165/167
062D
Plate Type Heat Exchanger

2,890,722 Loebel, F.A.; and Ewing, R.
1959 June 16,
138/38
162A
Heat Exchanger Tube

3,294,162 Loehlein, H.J.; and Curran, E.E.
1966 Dec. 27,
165/181
042C
Heat Exchanger Construction And Method For Making The Same

4,131,159 Long, W.A.
1978 Dec. 26,
165/166
062D
Heat Exchanger

4,118,944 Lord, R.G.; Bussjager, R.C.; and Geary, D.F.
1978 Oct. 10,
62/98
043A
High Performance Heat Exchanger

3,747,284 Lyczko, F.J.
1973 July 24,
51/267
142F
Cooling Apparatus

3,167,927 Lynch, P.J.; and Taylor, P.L.
1965 Feb. 2,
62/56
015F
Promotion Of Dropwise Condenstion

4,130,902 Mackenroth, J.R. III; and Bode, H.B.
1978 Dec. 26,
2/7
081F
Cooling Hatband

4,163,474 MacDonald, R.D.; Rose, R.K.; and Papsdorf
1979 Aug. 7
165/179
042A
Internally Finned Tube

4,163,474 MacDonald, R.D.; Rose, R.K.; and Papsdorf
1979 Aug. 7
165/179
042E
Internally Finned Tube

4,285,395 Masutani, K.; Horiguchi, A.; and Sumitomo, H.
1981 Aug 25
165/110
065D
Structure of Fluid Condensing and Heat Conducting surface of Condenser

3,384,165 Mathews, R.T.
1968 May 21,
165/122
042B
Heat Exchanger

4,194,560 Matsuzaki, Y.
1980 Mar. 25, Nihon Radiator Co., Ltd.
165/141
052A
Oil Cooler and Method for Forming It

2,553,142 McCreary, K.
1951 May 15,
29/157.3
042C
Method For Making Heat Exchangers

3,339,631 McGurty, J.A.; and Necker, W.C.
1967 Sept. 5,
165/109
043A
Heat Exchanger Utilizing Vortex Flow

3,831,675 McLain, C.D.
1974 Aug. 27,
165/177
022C
Heat Exchanger Tube

3,861,462 McLain, C.D.
1975 Jan. 21,
165/179
022A
Heat Exchange Tube

3,885,622 McLain, C.D.
1975 May 27,
165/179
022A
Heat Exchanger Tube

3,902,552 McLain, C.D.
1975 Sept. 2,
165/179
022A
Patterned Tubing

3,906,605 McLain, C.D.
1975 Sept. 23,
29/157.3 R
022A
Process For Preparing Heat Exchanger Tube

3,906,605 McLain, C.D.
1975 Sept. 23,
29/157.3 R
022C
Process For Preparing Heat Exchanger Tube

4,373,577 McMillen, R.G.
1983 Feb. 15, International Harvester Co.
165/122
042B
Heat Exchanger Assembly

4,090,559 Megerlin, F.E.
1978 May 23,
165/179
072A
Heat Transfer Device

4,034,804 Meijer, R.J.; and Mulder, J.
1977 July 12, U.S. Philips Corp.
165/148
042B
Motor-Car Radiator

4,269,265 Meyer, R.A.; and Bretl, R.A.
1981 May 26, Modine Manufacturing Company
165/109 T
032A
Tabular Heat Exchanger with Turbulator

3,137,184 Meyers, P.G.
1964 June 16,
77/55
141F
Tool Cooling Apparatus

2,932,491 Miller, L.M.
1960 April 12,
257/256
062D
Heat Transfer Unit

3,384,154 Milton, R.M.
1968 May 21,
165/1
015C
Heat Exchanger System

3,523,577 Milton, R.M.
1970 Aug. 11,
165/110
015C
Heat Exchange System

3,587,730 Milton, R.M.
1971 June 28,
165/110
015C
Heat Exchange System With Porous Boiling Layer

4,124,061 Mitchell, R.C. ETAL
1978 Nov. 7,
165/1
082F
Thermal Energy Storage Unit

4,354,550 Modahl, R. J.; and Luckeroth, V. C.
1982 Oct. 19, The Trane Company
165/133
013C
Heat Transfer Surface for Efficient Boiling of Liquid R-11 and Equivalents

3,598,180 Moore, R.D. Jr.
1971 Aug. 10,
165/133
083C
Heat Transfer Surface Structure

4,369,837 Moranne, J.-P.
1983 Jan. 25, Societe Anonyme des Usines Chausson
165/175
042B
Tube for Tube-Plate Heat Exchangers

4,369,837 Moranne, J.-P.
1983 Jan. 25, Societe Anonyme des Usines Chausson
165/175
042B
Tube for Tube-Plate Heat Exchangers

3,734,135 Mosier, J.A.
1973 May 22,
138/38
032A
Heat Exchanger With Internal Turbulater

4,360,058 Muellejans, H.
1982 Nov. 23, Sueddeutsche Kuehlerfabrik Julius Fr. Behr GmbH & Co.
165/104.21
025A
Process for the Preparation of a Surface of a Metal Wall for the fer of Heat

4,314,606 Muller, W.; Gauer, K.; Walkenhorst, W.; and Wild, G.
1982 Feb. 9, Hoechst Aktiengesellschaft
165/163
062C
Apparatus for a Treatment of Flowing Media Which Causes Heat Exchange and Mixing

4,332,291 Mulock-Bentley, D.
1982 Jun. 1, D. Mulock-Bentley and Associates
165/76
042B
Heat Exchanger with Slotted Fin Strips

4,184,540 Myreen, B.
1980 Jan. 22, RA-Shipping Ltd.
165/92
112B
Rotary Heat Exchanger

3,734,140 Nakamura, H.; and Tanaka, M.
1973 May 22,
138/177
024A
Cross-Rifled Vapor Generating Tubes

3,734,140 Nakamura, H.; and Tanaka, M.
1973 May 22,
138/177
022A
Cross-Rifled Vapor Generating Tubes

3,818,984 Nakamura, K.; and Kuroyanagi, M.
1974 June 25,
165/166
042E
Heat Exchanger

4,146,090 Nakayama, Y.; and Komana, N.
1979 Mar. 27,
165/166
062D
Plate Type Heat Exchanger

3,452,147 Narbut, P.; and Moore, C.L.
1969 June 24,
174/16
101F
Noncondensable Gas - Condensable Vapor Cooled Electri. Transformer

3,759,322 Nasser, G.E.D.; and Waldmann, H.
1973 Sept. 18,
165/166
062D
Heat Exchanger

4,368,776 Negita, J.; Yamada, Y.; Kaneko, H.; Ogino, T.
1983 Jan. 18, Nippondenso Co., Ltd.
165/133
042B
Aluminum Heat Exchanger

3,892,273 Nelson, B.E.
1975 July 1,
165/105
083A
Heat Pipe Lobar Wicking Arrangment

3,206,381 Neugebauer, F.J.; and Lustenader, E.L.
1965 Sept. 14,
202/185
015F
Dropwise Condensation Distillation Apparatus

2,613,066 Newlin, J.S.
1952 Oct. 7,
257/262.20
042B
Finned Tube Construction

3,875,997 Newson, I.H.; and Hodgson, T.D.
1975 April 8,
165/110
025A
Tubular Heat Transfer Members

3,762,468 Newson, I.H.; and Hodgson, T.D.
1973 Oct. 2,
165/177
085B
Heat Transfer Members

3,837,396 Newton, A.B.
1974 Sept. 24,
165/111
085A
Vertical Surface Vapor Condensers

3,903,962 Newton, A.B.
1975 Sept. 9,
165/110
085A
Condensate Guiding Apparatus For Vertical Condensing Tubes etc.

3,989,104 Newton, A.B.
1976 Nov. 2,
165/111
085A
Condenser Inserts

3,762,468 Newson, I.H.; and Hodgson, T.d.
1973 Oct.2,
165/177
084B
Heat Transfer Members

4,183,403 Nicholson, T.P.
1980 Jan. 15
165/166
0G2D
Plate Type Heat Exchangers

4, 154,294 Notaro, F.
1979 May 15,
165/133
015C
Enhanced condensation Heat Transfer Device and Method

3,692,105 O'Connor, J.M.
1972 Sept. 19,
165/181
042B
Heat Exchangers

3,781,959 O'Connor, J.M.
1974 Jan. 1,
29/157.3B
042B
Method Of Fabricating A Finned Heat Exchange Tube

3,947,941 O'Connor, J.M.: and Pasternak, S.F.
1976 April 6,
29/157.3B
042B
Method Of Making A Heat Exchanger

3,295,599 Okamoto, Y. ETAL
1967 Jan. 3,
165/184
042B
Heat Transfer Fin Heat Exchanging Tube

3,706,127 Oktay, S.; and Schmeckenbecher, A.F.
1972 Dec. 19,
29/576
032D
Method For Forming Heat Sinks On Semiconductor Device Chips

3,706,127 Oktay, S.; and Schmeckenbecher, A.F.
1972 Dec. 19, International Business Machines Corporation
29/576
041F
Method for Forming Heat Sinks on Semiconductor Device Chips

3,747,670 Palm, L.J.; and Palm, R.B.
1973 July 24,
165/1
072F
Thermal Fluid Heater

1,980,821 Palueff, K.K.
1934 Nov. 13,
175/265
141F
Means For Cooling Electrical Apparatus

4,073,340 Parker, K.O.
1978 Feb. 14,
165/166
062D
Formed Plate Type Heat Exchanger

2,244,800 Pascale, M.
1941 June 10,
257/262
042A
Heat Transfer Tube

2,244,800 Pascale, M.
1941 June 10,
257/262
042C
Heat Transfer Tube

3,746,086 Pasternak, S.F.
1973 July 17,
165/181
042B
Heat Exchangers

3,877,517 Pasternak, S.F.
1975, April 15,
165/146
042B
Heat Exchangers

3,901,312 Pasternak, S.F.
1975 Aug. 26,
165/181
042B
Heat Exchangers And Method Of Making Same

3,797,559 Paul, R.S.; and Weiler, D.W.
1974 March 19,
165/1
165A
Rotary Heat Exchanger And Apparatus

3,215,196 Pauls, T.F.
1965 Nov. 2,
165/179
042C
Metal Fabrication

3,502,137 Pawlowski, J.
1970 March 24,
165/1
112
Method Of Intensifying H.T. In Worms Having A Single Spindle

3,394,736 Pearson, J.F.
1968 July 30,
138/38
042A
Internal Finned Tube

3,407,871 Penney, W.R.
1968 Oct.29,
165/85
072A
Heat Exchanger

3,410,533 Penney, W.R.
1968 Nov. 12,
259/9
112A
Mixing Equipment

2,877,000 Person, F.W.
1959 March 10,
257/245
042E
Heat Exchanger

1,931,268 Philipp, L.A.
1933 Oct. 17,
62/126
054A
Refrigerating System

3,831,664 Pogson, J.T.
1974 Aug. 27,
165/80
062D
Heat Pipe Interfaces

3,045,138 Pohl, W.J.
1962 July 17,
313/21
023C
Electrical Discharge Tube

3,269,459 Popovitch, D.
1966 Aug. 30,
165/140
042B
Extensive Surface Heat Exchanger

3,916,984 Properzi, I.
1975 Nov. 4,
164/278
152
Cooling Device For Continuous Casting Machine

2,873,954 Protze, C.
1959 Feb. 17, Telefunken GmbH, Berlin
257/250
033F
Heat Exchanger for Electric Discharge Tube

3,684,007 Ragi, E.G.
1972 Aug. 15,
165/133
033C
Composite Structure For Boiling Liquids And Its Formation

2,161,887 Ramsaur, W.R.
1939 June 13,
138/38
072A
Turbulence Strip For Radiator Tubes

3,196,634 Rich, D.G.
1965 July 27,
62/394
015C
Refrigeration System

3,768,291 Rieger, K.K.
1973 Oct. 30, Universal Oil Products
72/78
022A
Method of Forming Spiral Ridges on the Inside Diameter of Externally Finned Tube

3,675,710 Ristow, R.E.
1972 July 11,
165/1
075A
High Efficiency Vapor Condenser and Method

3,675,710 Ristow, R.E.
1972 July 11,
165/1
155A
High Efficiency Vapor Condenser and Method

3,526,268 Robinson, M.
1970 Sept. 1,
165/1
142F
Corona Discharge Heat Transfer

2,514,797 Robinson, R.S.
1950 July 11,
257/73
132A
Heat Exchanger

2,463,997 Rodgers, J.S.
1949 March 8,
29/157.3
042A
Method Of Making Externally And Internally Finned Tubes

2,463,997 Rodgers, J.S.
1949 March 8,
29/157.3
042C
Method Of Making Externally And Internally Finned Tubes

3,217,799 Rodgers, J.S.
1965 Nov. 16,
165/179
025A
Steam Condenser Of The Water Tube Type

3,508,608 Roe, R.C.
1970 April 28,
165/179
085C
Condenser Tubes

3,240,683 Rogers, F.A.
1966 March 15,
202/173
065D
Distillation Apparatus For Treating Sea Water To Produce etc.

2,591,878 Rogers, P.S. ETAL
1952 April 8,
257/245
032D
Oxygen Regenerator

4,368,779 Rojey, A.; and Cohen, G.
1983 Jan. 18, Institut Francais du Petrole
165/165
042E
Compact Heat Exchanger

3,371,709 Rosenblad, C.F.
1968 March 5,
165/115
065D
Falling Film Plate Heat Exchanger

3,976,126 Ruff, K.
1976 Aug. 24,
165/110
042B
Air Cooled Surface Condenser

2,097,104 Saha, A.P.
1937 Oct. 26,
257/248
072A
Heat Exchange Apparatus

4,179,911 Saier, M.; Kastner, H-W.; and Klockler, R.
1979 Dec. 25, Wieland-Werke Aktiengesellschaft
72/78
023B
Y and T-Finned Tubes and Methods and Apparatus for Their Making

4,359,086 Sanborn, D. F.; Holman, J. L. M.; and Ware, C. D.
1982 Nov. 16, The Trane Company
165/133
013C
Heat Exchange Surface with Porous Coating and Subsurface Cavities

4,373,578 Saperstein, Z.P.; El-Bourini, R.M.; and Munch, J.E.
1983 Feb. 15, Modine Manufacturing Company
165/141
042B
Radiator with Heat Exchanger

3,973,623 Sarll, P.G.
1976 Aug. 10,
165/94
112
Heat Exchange Apparatus

4,330,036 Satoh, Y; and Higo, T.
1982 May 18, Kobe Steel, Ltd.
165/179
045C
Construction of a Heat Transfer Wall and Heat Transfer Pipe and Method of Producing Heat Transfer Pipe

4,330,036 Satoh, Y; and Higo, T.
1982 May 18, Kobe Steel, Ltd.
165/179
022A
Construction of a Heat Transfer Wall and Heat Transfer Pipe and Method of Producing Heat Transfer Pipe

4,283,024 Schatz, F.; and Ziemek, G.
1981 Aug. 18, Kabel-und Metallwerke Gutehoffnungshuette AG
29/157.4
022A
Method for Manufacturing Heat Exchanger Tubing

3,669,186 Schauls, J.J.
1972 June 13,
165/166
062D
Distributor For Plate Type Heat Exchangers Having End Headers

3,860,065 Schauls, J.J.
1975 Jan. 14,
165/166
062E
Distributor For Plate Type Heat Exchanger Having Side Headers

3,983,191 Schauls, J.J.
1976 Sept. 28,
261/114P
062D
Brazed Plate Type H-X For Nonadiabatic Rectification

3,559,722 Schauls, J.L.; and Duncan, F.D.
1971 Feb. 2,
159/16
062D
Method And Apparatus For Two Phase H.X. Fluid Distribution etc.

4,060,126 Schladitz, H.J.
1977 Nov. 29,
165/133
022F
H.T. Between Solids And Fluids Utilizing Polycrystalline etc.

4,060,126 Schladitz, H.J.
1977, Nov. 29
165/133
041F
Heat Transfer Between Solids and Fluids Utilizing Polycrystalline Metal

1,916,337 Schmidt, W.A.
1933 July 4,
072A
Heat Interchanging Apparatus

1,916,337 Schmidt, W.A.
1933 July 4,
102A
Heat Interchanging Apparatus

4,074,753 Schmittle, K.V.; and Starner, K.E.
1978 Feb. 21,
165/184
043C
Heat Transfer In Pool Boiling

3,209,062 Scholz, C.F.
1965 Sept. 28,
174/15
042E
Mounting And Cooling Syst. For Semi-Conductor Heat Generating Dev.

3,163,207 Schultz, R.T.
1964 Dec. 29,
165/68
042F
Heat Dissipating Mount For Electronic Components

3,804,159 Searight, E.F.; and Brosens, P.J.
1974 April 16,
165/109
042B
Jet Impingement Fin Coil

4,108,242 Searight, E.F.; and Flanagan, P.
1978 Aug. 22,
165/164
062D
Jet Impingement Heat Exchanger

3,457,982 Sephton, H. H.
1969 July 29,
159/13
076A
Evaporation and Distillation Apparatus

3,423,294 Sephton, H.H.
1969 June 21,
203/10
074A
Vortex Flow Film Distillation Process

3,648,754 Sephton, H.H.
1972 March 14,
153/13A
074A
Vortex Flow For Enhancing Interfacial Surface & Heat & Mass Transf

3,846,254 Sephton, H.H.
1974 Nov. 5,
203/11
085A
Interface Enhancement Applied To Evaporation Of Liquids

3,846,254 Sephton, H.H.
1974 Nov.5.
203/11
042A
Interface Enhancement Applied To Evaporation of Lignids

1,838,043 Sherwood, T.K.
1931 Dec. 22,
112F
Apparatus And Method For Heat Exchangers

4,095,648 Shipes, K.V.
1978 June 20,
165/162
042B
Tube Bundles

3,814,172 Shore, D.T.
1974 June 4,
165/12
122D
Heat Exchangers

4,182,412 Shum, M.S.
1980 Jan. 8, UOP Inc.
165/133
023B
Finned Heat Transfer Tube with Porous Boiling Surface and
Method for Producing Same

2,789,797 Simpelaar, C.S.
1957 April 23,
257/245
042E
Heat Exchanger Fin Structure

4,094,165 Sisk, F.J.
1978,June 13,
62/115
112
Loss Heat Suppression Apparatus And Method For Heat Pump

3,759,050 Slaasted, R.S.; and Dudley, J.C.
1973 Sept. 18,
62/93
065D
Method Of Cooling A Gas And Removing Moisture Therefrom

4,311,187 Small, W.M.
1982 Jan. 19, Phillips Petroleum Company
165/1
032C
Vortex Generators

4,044,796 Smick, R.H.
1977 Aug. 30,
138/38
072A
Turbulator

4,296,779 Smick, R.H.
1981 Oct. 27,
138/38
032A
Turbulator with Ganged Strips

3,398,784 Smith, J.W.; and Gowen, R.A.
1968 Aug.27,
165/1
022A
Method Of Heat Exchange With High Viscosity Liquids

4,126,177 Smith, R.L.; and Yann, C.C.
1978 Nov. 21,
165/91
112
Dual Scraped Surface Heat Exchanger

2,870,999 Soderstrom, S.H.
1959 Jan. 27,
257/262.20
042C
Heat Exchange Element

3,807,496 Stadmark, N.H.G.
1974 April 30,
165/167
062D
Heat Exchange Plates

3,289,752 Staub, F.W.
1966 Dec. 6,
165/110
035D
Condensing Heat Transfer Device

3,887,759 Staub, F.W.; and Kosky, P.G.
1975 June 3,
174/15 R
023F
Evaporative Cooling Syst. Employing Liquid Film Evaporation etc.

3,187,812 Staver, E.F.
1965 June 8,
165/185
042E
Heat Dissipator For Electronic Circuitry

3,056,587 Steigerwald, K.H.
1962 Oct. 2,
257/1
142F
Methods Of Effecting A High Rate Of H.T. From A Heated Surf. etc.

3,228,464 Stein, W.J.; and Banthin, C.R.
1966 Jan. 11,
165/166
062D
Corrugated Plate Counter Flow Heat Exchanger

1,716,743 Still, W.J.
1929 June 11
042B
Heat Transmitting Tube

4,351,392 Stockman, R. F.
1982 Sep. 28, Combustion Engineering, Inc.
165/186
042A
Heat Exchange Tube with Heat Absorptive Shield

4,121,654 Stockman, R.F.
1978 Oct. 24,
165/6
112
Dry Cooling Tower

2,118,060 Stone, R.H.; and Tilley, E.F.
1938 May 24,
257/262
042B
Finned Tube

4,180,129 Sumitomo, H.
1979 Dec. 25, Hisaka Works, Ltd.
165/110
065D
Plate Type Condenser

4,184,542 Sumitomo, H.
1980 Jan. 22, Hisaka Works, Ltd.
165/166
065D
Plate Type Condenser

4,216,825 Sumitomo, H.
1980 Aug. 12, Hisaka Works, Ltd.
165/109 R
013D
Plate Type Evaporator

4,228,850 Sumitomo, H.
1980 Oct. 21, Hisaka Works, Ltd.
165/110
065D
Plate Used in Condenser

4,347,897 Sumitomo, H.; and Uehara, H.
1982, Sep. 7, Hisaka Works, Ltd.
165/167
152D
Plate Type Heat Exchanger

4,314,605 Sumitomo, H.; Doi, M.; Kobayashi, K.; Fukami, K.; and Kawanishi, K.
1982 Feb. 9, Hisaka Works, Ltd.
165/110
085D
Condenser

4,182,411 Sumitomo, H.; Fukami, K;, Kobayashi, K.; Doi, M., Kawanishi, K. and Yoshida, K.
1980 Jan. 8, Hisaka Works Ltd.
165/110
065D
Plate Type Condenser

3,566,514 Szumigala, E.T.
1971 March 2,
29/558
023F
Manufacturing Method For Boiling Surfaces

3,457,990 Theophilos, N.P.; and Wang, D.I.J.
1969 July 29,
165/133
023A
Multiple Passage Heat Exchanger Utilizing Nucleate Boiling

3,457,990 Theophilous, N.P.; and Wang, D.I.J.
1969 July 29,
165/133
045A
Multiple Passage Heat Exchanger Utilizing Nucleate Boiling

3,302,701 Thomas, D.G.
1967 Feb. 7,
165/109
022F
Turbulence Promoter For Increased Heat And Mass Transfer

3,302,701 Thomas, D.G.
1967 Feb. 7,
165/109
026F
Turbulence Promoter For Increased Heat and Mass Transfer

3,358,750 Thomas, D.G.
1967 Dec. 19,
165/177
035C
Condenser Tube

3,881,342 Thorne, J.K.
1975 May 6,
72/68
043C
Method For Making Integral Finned Tubes For Submerged Boiling

4,059,147 Thorne, J.K.
1977 Nov. 22,
165/133
043C
Integral Finned Tube For Submerged Boiling Applications etc.

3,433,294 Timson, W.J.
1969 March 18,
165/1
015F
Boiling Heat Transfer System

4,228,852 Togashi, A.
1980 Oct. 21
165/173
022A
Tubular Body

4,245,697 Togashi, A.
1981 Jan. 20
165/179
022A
Tubular Body

3,529,661 Tousch, T.
1970 Sept. 22,
165/87
112B
Rotary Material Processor with Hollow Material Contacting Elements

2,181,927 Townsend, A.J.
1939 Dec. 5,
29/157.3
165A
Heat Exchanger And Method Of Making Same

2,227,680 Townsend, A.J.; and Bascombe, F.J.
1941 Jan. 7,
257/262
042B
Finned Tubing Or The Like

4,286,655 Trojani, B.L.
1981 Sep. 1
165/179
042A
Finned Tube for Heat Exchangers

4,300,630 Trojani, B.L.
1981 Nov. 17
165/181
042B
Finned Metal Tube and Method for Making the Same

4,306,619 Trojani, B.L.
1981 Dec. 22
165/179
042A
Tube Provided with Inner Fins and Outer Fins or Pins, Particularly for Heat Exchangers, and Method Therefor

4,186,798 Tseluiko, J.I.; Kutsykovich, D.B.; Shabelnikova, L.A., Kholopov, V., Schekin, N.G., Gritsuk, L.D., Katsenelenbogen, L.B.
1980 Feb. 5
165/147
054A
Tubular Cooled Members of Metallurgical Furnace

4,230,179 Uehara, H.; and Miyoshi, M.
1980 Oct. 28, Haruo Uehara; Tokyo Shibaura Denki Kabushiki Kaisha
165/113
065D
Plate Type Condensers

4,237,970 Uehara, H.; and Miyoshi, M.
1980 Dec. 9, Haruo Uehara; Denki Kabushiki Kaisha
165/110
085D
Plate Type Condensers

4,184,544 Ullmer, H.J.
1980 Jan. 22
165/184
041B
Apparatus and Method for Recovering Waste Heat From Flue Gases

2,919,115 Vaaler, L.E.
1959 Dec. 29,
257/58
015F
Impregnated Porous Condenser Surface

2,962,265 Van Luik, Jr., F.W.
1960 Nov. 29,
257/43
145B
Vapor-Liquid Phase Conversions

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1960 Nov. 29,
257/43
145C
Vapor-Liquid Phase Conversion

4,311,193 Verhaeghe, R.C.; and Huggins, H.D.
1982 Jan. 19, Modine Manufacturing Company
165/149
042B
Serpentine Fin Heat Exchanger

4,346,760 Vidal-Meza, G.D.
1982 Aug. 31, Caterpillar Tractor Co.
165/166
042E
Heat Exchanger Plate Having Distortion Resistant Uniform Pleats

4,286,366 Vinyard, R.E.
1981 Sep. 1, Phillips Petroleum Company
29/157.4
032C/B
Method for the Construction of a Baffled Heat Exchanger

4,186,779 Wagner, W.T.
1980 Feb. 5, Dayco Corporation
138/121
022A
Corrugated Metal Tube

3,288,209 Wall, A.J.; and Palmer, A.
1966 Nov. 29,
165/184
042B
Heat Transmitting Tubes Having Helical Fin Means

3,955,617 Walsh, J.C.
1976 May 11,
165/94
112
Swept Surface Heat Exchanger With Dual Heat Exchange Media

3,326,283 Ware, C.D.
1967 June 29,
165/181
043C
Heat Transfer Surface

3,225,824 Wartenberg, K.
1965 Dec. 28,
165/122
045E
Air Cooled Heat Exchanger For Cooling Liquid Media

3,534,555 Webb, J.E.
1970 Oct. 20,
60/217
092A
Laminar Flow Enhancement

3,521,708 Webb, R.L.
1970 July 28,
165/186
043C
Heat Transfer Surface Which Promotes Nucleate Ebullition

3,696,861 Webb, R.L.
1972 Oct. 10,
165/133
043C
Heat Transfer Surface Having A High Boiling H.T. Cofficient

4,223,539 Webb, R.L.; and Mougin, L.J.
1980 Sep. 23, The Trane Company
62/476
086C
Apparatus for Absorbing a Vapor in a Liquid and Absorption Refrigeration System Incorporating Same

3,595,299 Weishaupt, J.; Waldman, H.; and Haring, T.
1971 July 27,
159/28D
032A
Apparatus For The Evaporation Of Low Temp. Liquified Gases

2,872,165 Wennerberg, F.J.
1959 Feb. 3,
257/245
062D
Plate Type Heat Exchangers

3,665,573 Werner, R.W.; Alexander, E.E.; and Comstock, I.J.
1972 May 30,
29/157.3
083A
Method Of Fabricating A Heat Pipe

3,921,711 Westbrock, A.J.
1975 Nov. 25,
165/109
052A
Turbulator

3,578,075 Winter, J.
1971 May 11,
165/177
022C
Corrugated Tubing

3,481,394 Withers, J.G. Jr.
1969 Dec. 2,
165/179
045C
Configuration Of H.T. Tubing For Vapour Condensation etc.

4,007,774 Withers, J.G. Jr.
1977 Feb. 15,
165/1
042A
H-X Apparatus And Method Of Controlling Fouling Therein

3,847,212 Withers, J.G. Jr.; and Rieger, K.K.
1974 Nov.12,
165/179
022A
Heat Transfer Tube Having Multiple Internal Ridges

3,779,312 Withers, J.G. Jr.; Habdas, E.P.; and Jurmo, M.W.
1973 Dec. 18,
165/184
022A
Internally Ridged Heat Transfer Tube

3,826,304 Withers, J.G.; Dean, H.R.; and Ross, S.T.
1974 July 30,
165/1
024A
Advantageous Configuration Of Tubing For Internal Boiling

3,559,437 Withers, Jr., J.G.
1971, Feb. 2
72/96
022A
Method and Apparatus for Making Heat Transfer Tubing

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1971, Feb. 2
72/96
045C
Method and Apparatus for Making Heat Transfer Tubing

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1977 Feb. 15, UOP Inc.
165/1
022A
Heat Exchange Apparatus and Method of Controlling Fouling Therein

4,219,078 Withers, Jr., J.G.
1980 Aug. 26, UOP Inc.
165/133
013F
Heat Transfer Surface for Nucleate Boiling

4,288,897 Withers, Jr., J.G.
1981 Sep. 15, UOP Inc.
29/157.4
013C
Method of Producing a Nucleate Boiling Surface on a Heat Transfer Member

2,234,423 Wittmann, R. A.
1941 Mar. 11, Thermek Corp.
122/333
042B
Heating Means

3,450,193 Wolfe, W. Jr.
1969 June 17,
165/1
045C
Corrugated Tubing

4,141,409 Woodhull,I.D.Jr.; and Liedel, T.H.
1979 Feb. 27,
165/110
045F
Condenser Header Construction

3,232,341 Woodworth, L.R.
1966 Feb. 1,
165/111
075A
Condenser

2,664,274 Worn, G.A.; and Rubin, F.L.
1953, Dec. 29,
257/73
132A
Method And Apparatus Employing Sonic Waves In Heat Exchange

3,469,626 Wright. F.W.; and Wilson, A.H.
1969 Sept. 30,
165/166
062D
Plate Heat Exchangers

3,152,774 Wyatt, T.
1964 Oct. 13,
244/1
083F
Satellite Temperature Stabilization System

3,152,774 Wyatt, T.
1964 Oct. 13,
244/1
085F
Satellite Temperature Stabilization System

4,305,460 Yampolsky, J.S.
1981 Dec. 15, General Atomic Company
165/179
042A
Heat Transfer Tube

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1981 Dec. 15, General Atomic Company
165/179
085C
Heat Transfer Tube

4,182,410 Yoshida, K.; Kobayashi, K.; and Sumitomo, H.
1980 Jan 8, Hisaka Works Ltd.
165/110
065D
Plate Type Condenser

4,051,898 Yoshino, M.; and Oguri, A.
1977 Oct. 4,
165/166
162F
Static Heat And Moisture Exchanger

3,768,290 Zatell, V.A.
1973 Oct. 30,
72/68
043C
Method Of Modifying A Finned Tube For Boiling Enhancement

4,071,934 Zolman, J.O.; and Griewahn, C.O.
1978 Feb. 7,
29/157.3 A
042B
CFT Box Fin

3,392,781 Zuber, N.; and Lustenader, E.L.
1968 July 16,
165/135
023A
Vaporizing Heat Transfer Device

LIST BY TECHNIQUE-MODE

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4,093,755 Dahl, M.M.; and Erb, L.D.
1978, June 6, The Gates Rubber Company
427/299
013B
Method for Making a Liquid Heat Exchanger Coating

4,186,063 Albertson, C.E.; Nichols, G.M.; and Rasmussen, N.
1980 Jan. 29, Borg-Warner Corporation
204/29
013B
Boiling Heat Transfer Surface, Method of Preparing Same and Method of Boiling

4,060,125 Fujie, K. ETAL
1977 Nov. 29,
165/133
013C
Heat Transfer Wall For Boiling Liquids

4,288,897 Withers, Jr., J.G.
1981 Sep. 15, UOP Inc.
29/157.4
013C
Method of Producing a Nucleate Boiling Surface on a Heat Transfer Member

4,291,758 Fujii, M.; Ogawa, Y.; and Morihiro, Y.
1981 Sep. 29, Mitsubishi Denki Kabushiki Kaisha
165/133
013C
Preparation of Boiling Heat Transfer Surface

4,354,550 Modahl, R. J.; and Luckeroth, V. C.
1982 Oct. 19, The Trane Company
165/133
013C
Heat Transfer Surface for Efficient Boiling of Liquid R-11 and Equivalents

4,359,086 Sanborn, D. F.; Holman, J. L. M.; and Ware, C. D.
1982 Nov. 16, The Trane Company
165/133
013C
Heat Exchange Surface with Porous Coating and Subsurface Cavities

4,216,825 Sumitomo, H.
1980 Aug. 12, Hisaka Works, Ltd.
165/109 R
013D
Plate Type Evaporator

4,211,276 Itoh, M.; Takasuna, T.; Ishikawa, Y.; Kimura, H.; and Musoh, M.
1980 Jul. 8, Hitachi, Ltd.
165/1
013E
Method of Making Fin Elements for Heat Exchangers

3,207,209 Hummel, R.L.
1965 Sept. 21,
165/1
013F
Means For Increasing The H.T. Coeficient Between A Wall And etc.

3,990,862 Dahl, M.M.; and Erb, L.D.
1976 Nov. 9,
29/191.2
013F
Liquid Heat Exchanger Interface And Method

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1980 Aug. 26, UOP Inc.
165/133
013F
Heat Transfer Surface for Nucleate Boiling

4,352,392 Eastman, G.Y.
1982 Oct. 5, Thermacore, Inc.
165/104.25
013F
Mechanically Assisted Evaporator Surface

4,154,293 Fenner, G.W.; and Raqi, E.G.
1979 May 15,
165/133
014A
Enhanced Tube Inner Surface Heat Transfer Device and Method

4,123,837 Horner, T.M.
1978 Nov. 7,
29/157.3B
014C
Heat Transfer Method

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1979 May 15,
165/133
015A
Enhanced Tube Inner Surface Heat Transfer Device and Method

2,923,640 Buckingham, W.T.
1960 Feb. 2,
117/49
015B
Method Of Applying A Plastic Coating

3,196,634 Rich, D.G.
1965 July 27,
62/394
015C
Refrigeration System

3,384,154 Milton, R.M.
1968 May 21,
165/1
015C
Heat Exchanger System

3,523,577 Milton, R.M.
1970 Aug. 11,
165/110
015C
Heat Exchange System

3,587,730 Milton, R.M.
1971 June 28,
165/110
015C
Heat Exchange System With Porous Boiling Layer

3,821,018 Grant, A.C.
1974 June 28,
117/94
015C
Porous Metallic Layer Formation

3,825,064 Inoue, K.
1974 July 23,
165/179
015C
Heat Exchanger

4, 154,294 Notaro, F.
1979 May 15,
165/133
015C
Enhanced condensation Heat Transfer Device and Method

4,018,264 Albertson, C.E.
1977 April 19,
165/1
015C
Boiling Heat Transfer Surface And Method

4,064,914 Grant, A.C.
1977 Dec. 27,
138/142
015C
Porous Metallic Layer And Formation

4,129,181 Janowski, K.R.; Shum, M.S.; and Bradley, S.A.
1978 Dec. 12,
165/133
015C
Heat Transfer Surface

2,394,698 Kuenhold, O.J. Sr.
1946 Feb. 12,
261/104
015F
Evaporator

2,919,115 Vaaler, L.E.
1959 Dec. 29,
257/58
015F
Impregnated Porous Condenser Surface

3,167,927 Lynch, P.J.; and Taylor, P.L.
1965 Feb. 2,
62/56
015F
Promotion Of Dropwise Condenstion

3,206,381 Neugebauer, F.J.; and Lustenader, E.L.
1965 Sept. 14,
202/185
015F
Dropwise Condensation Distillation Apparatus

3,229,759 Grover, G.M.
1966 Jan. 18,
165/105
015F
Evaporation-Condensation Heat Transfer Device

3,298,427 Erb, R.A.
1967 Jan. 17,
165/1
015F
Method And Apparatus For Dropwise Condensation

3,301,314 Gaertner, R.F.
1967 Jan. 31,
165/1
015F
Method And Means For Increasing The H.T. Coefficient etc.

3,433,294 Timson, W.J.
1969 March 18,
165/1
015F
Boiling Heat Transfer System

3,466,189 Erb, R.A.
1969 Sept. 9,
117/132
015F
Method For Improving Heat Transfer In Condensers

3,015,355 Humphrey, A.H.
1962 Jan. 2, General Gas Light Company
153/78
022A
Method for Forming Spirally Ribbed Tubing

3,128,821 Andersen, R. C.
1964 Apr. 14, Flexonics Corp.
153/71
022A
Corrugator for Metal Tubing

3,398,784 Smith, J.W.; and Gowen, R.A.
1968 Aug.27,
165/1
022A
Method Of Heat Exchange With High Viscosity Liquids

3,559,437 Withers, Jr., J.G.
1971, Feb. 2
72/96
022A
Method and Apparatus for Making Heat Transfer Tubing

3,622,403 French, P.W.
1971 Nov. 23,
148/11.5
022A
Production Of Metal Tubing With Rough Inner Surfaces

3,734,140 Nakamura, H.; and Tanaka, M.
1973 May 22,
138/177
022A
Cross-Rifled Vapor Generating Tubes

3,768,291 Rieger, K.K.
1973 Oct. 30, Universal Oil Products
72/78
022A
Method of Forming Spiral Ridges on the Inside Diameter of Externally Finned Tube

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1973 Dec. 18,
165/184
022A
Internally Ridged Heat Transfer Tube

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1974 Nov.12,
165/179
022A
Heat Transfer Tube Having Multiple Internal Ridges

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1975 Jan. 21,
165/179
022A
Heat Exchange Tube

3,865,184 Grover. G.M.
1975 Feb. 11,
165/105
022A
Heat Pipe And Method And Apparatus For Fabricating Same

3,885,622 McLain, C.D.
1975 May 27,
165/179
022A
Heat Exchanger Tube

3,902,552 McLain, C.D.
1975 Sept. 2,
165/179
022A
Patterned Tubing

3,906,605 McLain, C.D.
1975 Sept. 23,
29/157.3 R
022A
Process For Preparing Heat Exchanger Tube

4,186,779 Wagner, W.T.
1980 Feb. 5, Dayco Corporation
138/121
022A
Corrugated Metal Tube

4,228,852 Togashi, A.
1900 Oct. 21
165/173
022A
Tubular Body

4,232,728 Fenner, G.W.; and Ragi, E.G.
1980 Nov. 11, Union Carbide Corporation
165/1
022A
Method for Enhanced Heat Transfer

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1981 Jan. 20
165/179
022A
Tubular Body

4,283,824 Schatz, F.; and Ziemek, G.
1981 Aug. 18, Kabel-und Metallwerke Gutehoffnungshuette AG
29/157.4
022A
Method for Manufacturing Heat Exchanger Tubing

4,330,036 Satoh, Y; and Higo, T.
1982 May 18, Kobe Steel, Ltd.
165/179
022A
Construction of a Heat Transfer Wall and Heat Transfer Pipe and Method of Producing Heat Transfer Pipe

4,351,389 Guarnaschelli, S.
1982 Sep. 28,
165/141
022A
Heat Exchanger Apparatus

3,154,141 Huet, A.
1964 Oct. 27,
165/133
022C
Roughened Heat Exchanger Tube

3,397,440 Dalin, D.
1968 Aug. 20,
29/157.3
022C
Method Of Making Heat Exchanger Having Extended Surface

3,578,075 Winter, J.
1971 May 11,
165/177
022C
Corrugated Tubing

3,612,175 Ford, J.A.; and Wolfe, W. Jr.
1971 Oct. 12,
165/179
022C
Corrugated Metal Tubing

3,831,675 McLain, C.D.
1974 Aug. 27,
165/177
022C
Heat Exchanger Tube

3,850,227 Ford, J.A.
1974 Nov. 26,
165/1
022C
Process For Improving Heat Transfer Efficiency etc.

3,906,605 McLain, C.D.
1975 Sept. 23,
29/157.3 R
022C
Process For Preparing Heat Exchanger Tube

1,680,145 Forssblad, N.R.
1928 Aug. 7,
022D
Heat Exchanger

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1928 Aug. 7,
022F
Heat Exchanger

3,302,701 Thomas, D.G.
1967 Feb. 7,
165/109
022F
Turbulence Promoter For Increased Heat And Mass Transfer

3,705,618 Jouet, E.; and Rebuffe, P.
1972 Dec. 12,
165/166
022F
Heat Exchanger

4,060,126 Schladitz, H.J.
1977 Nov. 29,
165/133
022F
H.T. Between Solids And Fluids Utilizing Polycrystalline etc.

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1942 April 14,
122/235
023A
Liquid Vaporizing Tube

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1951 Aug. 21,
261/104
023A
Refrigerating Apparatus

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1968 July 16,
165/135
023A
Vaporizing Heat Transfer Device

3,454,081 Kun, L.C.; and Czikk, A.M.
1969 July 8,
165/133
023A
Surface For Boiling Liquids

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1969 July 29,
165/133
023A
Multiple Passage Heat Exchanger Utilizing Nucleate Boiling

4,044,797 Fujie, K. ETAL
1977 Aug. 30,
138/38
023A
Heat Transfer Pipe

3,602,027 Klug, W.A.; and Ware, C.D.
1971 Aug. 31, The Trane Company
72/98
023B
Simultaneous Finning and Reforming of Tubular Heat Transfer Surface

4,179,911 Saier, M.; Kastner, H-W.; and Klockler, R.
197º Dec. 25, Wieland-Werke Aktiengesellschaft
72/78
023B
Y and T-Finned Tubes and Methods and Apparatus for Their Making

4,182,412 Shum, M.S.
1980 Jan. 8, UOP Inc.
165/133
023B
Finned Heat Transfer Tube with Porous Boiling Surface and
Method for Producing Same

3,045,138 Pohl, W.J.
1962 July 17,
313/21
023C
Electrical Discharge Tube

3,521,705 Beutheret, C. A.; and Douquet, E. J.
1970 July 28, Compagnie Francaise Thomson Houston-Hotchkiss Brandt
165/74
023C
Heat Exchange Structure and Electron Tube Including Such Exchange
Structure

4,216,826 Fujikake, J.
1980 Aug. 12, Furukawa Metals Co., Ltd.
165/133
023C
Heat Transfer Tube for Use in Boiling Type Heat Exchangers
and Method of Producing the Same

4,258,783 Albertson, C.E.; Nichols, G.M.; and Rasmussen, J.N.
1981 Mar. 31, Borg-Warner Corporation
165/133
023C
Boiling Heat Transfer Surface, Method of Preparing Same and Method of Boiling

4,313,248 Fujikake, J.
1982 Feb. 2, Fukurawa Metals Co., Ltd.
29/157.3 A
023C
Method of Producing Heat Transfer Tube for Use in Boiling Type Heat Exchangers

3,566,514 Szumigala, E.T.
1971 March 2,
29/558
023F
Manufacturing Method For Boiling Surfaces

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1975 June 3,
174/15 R
023F
Evaporative Cooling Syst. Employing Liquid Film Evaporation etc.

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1975 Sept. 23,
29/157.3A
023F
Method For Forming Heat Transmissive Wall Surface

4,050,507 Chu, R.C.; and Moran, K.P.
1977 Sept. 27,
165/1
023F
Method For Customizing Nucleate Boiling H.T. From Electronic etc.

3,734,140 Nakamura, H.; and Tanaka, M.
1973 May 22,
138/177
024A
Cross-Rifled Vapor Generating Tubes

3,826,304 Withers, J.G.; Dean, H.R.; and Ross, S.T.
1974 July 30,
165/1
024A
Advantageous Configuration Of Tubing For Internal Boiling

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1982 Feb. 9, Combustion Engineering, Inc.
138/38
024A
Rib Design for Boiler Tubes

4,369,837 Moranne, J-P.
1983 Jan. 25, Societe Anonyme des Usines Chausson
165/175
024B
Tube for Tube-Plate Heat Exchangers

3,217,799 Rodgers, J.S.
1965 Nov. 16,
165/179
025A
Steam Condenser Of The Water Tube Type

3,875,997 Newson, I.H.; and Hodgson, T.D.
1975 April 8,
165/110
025A
Tubular Heat Transfer Members

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165/1
025A
Method for Enhanced Heat Transfer

4,360,058 Muellejans, H.
1982 Nov. 23, Sueddeutsche Kuehlerfabrik Julius Fr. Behr GmbH & Co.
165/104.21
025A
Process for the Preparation of a Surface of a Metal Wall for the
fer of Heat

4,195,688 Fujie, K.; Nakayama, W.; Kuwahara, H.; Daikoku, T.; and
Kakizaki, K.
1980 Apr. 1, Hitachi, Itd.; Hitachi Cable, Ltd.
165/133
025B
Heat-Transfer Wall for Condensation and Method of Manufacturing
the Same

3,244,601 Diedrich, G.E.
1966 April 5,
202/236
025C
Fluted Tubular Distillation Apparatus

3,789,915 Ford, J.A.
1974 Feb. 5,
165/1
025C
Process For Improving H.T. Efficiency And Improved H.T. System

4,245,695 Fujikake, J.
1981 Jan. 20, Furukawa Metals Co., Ltd.
165/133
025C
Heat Transfer Tube for Condensation and Method for
Manufacturing Same

3,302,701 Thomas, D.G.
1967 Feb. 7,
165/109
026F
Turbulence Promoter For Increased Heat and Mass Transfer

3,595,299 Weishaupt, J.; Waldman, H.; and Haring, T.
1971 July 27,
159/28D
032A
Apparatus For The Evaporation Of Low Temp. Liquified Gases

3,734,135 Mosier, J.A.
1973 May 22,
138/38
032A
Heat Exchanger With Internal Turbulater

3,771,589 Lage, J.R.
1973 Nov. 13,
165/1
032A
Method And Apparatus For Improved Transfer Of Heat

3,981,356 Granetzke, D.C.
1976 Sept. 21,
165/179
032A
Heat Exchanger

4,269,265 Meyer, R.A.; and Bretl, R.A.
1981 May 26, Modine Manufacturing Company
165/109 T
032A
Tabular Heat Exchanger with Turbulator

4,296,779 Smick, R.H.
1981 Oct. 27,
138/38
032A
Turbulator with Ganged Strips

4,342,360 Gentry, C.C.
1982 Aug. 3, Phillips Petroleum Co.
165/67
032B
Rod Baffled Heat Exchanger

3,202,210 Hughes, R.W.
1965 Aug. 24,
165/154
032C
Heat Exchanger

3,330,336 Gobel, G.
1967 July 11,
165/160
032C
Heat Exchanger Tubes With Longitudinal Ribs

4,311,187 Small, W.M.
1982 Jan. 19, Phillips Petroleum Company
165/1
032C
Vortex Generators

4,286,366 Vinyard, R.E.
1981 Sep. 1, Phillips Petroleum Company
29/157.4
032C/B
Method for the Construction of a Baffled Heat Exchanger

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1950 Nov. 7,
257/245
032D
Heat Exchanger

2,591,878 Rogers, P.S. ETAL
1952 April 8,
257/245
032D
Oxygen Regenerator

3,706,127 Oktay, S.; and Schmeckenbecher, A.F.
1972 Dec. 19,
29/576
032D
Method For Forming Heat Sinks On Semiconductor Device Chips

3,741,285 Kuethe, A.M.
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165/1
032D
Boundary Layer Control of Flow Separation and Heat Exchange

4,365,667 Hatada, T.; Senshu, T.; Arai, A.; Harada, F.; Matsuzaki, A.; atari, H.; Imaizumi, Y.; Takeda, S.
1982 Dec. 28, Hitachi, Ltd.
165/152
032E
Heat Exchanger

3,247,583 Hansson, A.; and Brick, R.M.
1966 Apr. 26, Continental Car Company, Inc.
29/157.3
032F
Production of Externally Finned Sheet Stock

3,684,007 Ragi, E.G.
1972 Aug. 15,
165/133
033C
Composite Structure For Boiling Liquids And Its Formation

4,156,459 Kusuda, H.; and Uehara, H.
1979 May 29,
165/167
033D
Plate Type Evaporator

2,873,954 Protze, C.
1959 Feb. 17, Telefunken GmbH, Berlin
257/250
033F
Heat Exchanger for Electric Discharge Tube

4,253,519 Kun, L.C.; and Ragi, E.G.
1981 Mar. 3, Union Carbide Corporation
165/110
035B
Enhancement for Film Condensation Apparatus

3,358,750 Thomas, D.G.
1967 Dec. 19,
165/177
035C
Condenser Tube

3,289,752 Staub, F.W.
1966 Dec. 6,
165/110
035D
Condensing Heat Transfer Device

4,184,544 Ullmer, H.J.
1900 Jan. 22
165/184
041B
Apparatus and Method for Recovering Waste Heat From Flue Gases

4,236,578 Kreith, F. and Cornelison, R.C.
1980 Dec. 2, Condar, Co.
165/181
041B
Heat Exchange Enhancement Structure

4,369,838 Asanuma, Y.; and Showa, K.
1983 Jan. 25, Aluminum Kabushiki Kaisha Showa
165/185
041E
Device for Releasing Heat

3,706,127 Oktay, S.; and Schmeckenbecher, A.F.
1972 Dec. 19, International Business Machines Corporation
29/576
041F
Method for Forming Heat Sinks on Semiconductor Device Chips

4,060,126 Schladitz, H.J.
1977, Nov. 29
165/133
041F
Heat Transfer Between Solids and Fluids Utilizing Polycrystalline Metal

3,273,599 Heeren, H.
1966 Sept. 20,
138/38
042A
Internally Finned Condenser Tube

2,244,800 Pascale, M.
1941 June 10,
257/262
042A
Heat Transfer Tube

2,432,308 Goodyer, H.J.
1947 Dec. 9,
210/57
042A
Conduit Having Annular Ribs, A Sump, And Sediment Directing Means

2,463,997 Rodgers, J.S.
1949 March 8,
29/157.3
042A
Method Of Making Externally And Internally Finned Tubes

2,895,508 Drake, C.E.
1959 July 21,
138/38
042A
Heat Exchanger Conduit

3,229,722 Kritzer, R.W.
1966 Jan. 18,
138/39
042A
Heat Exchange Element With Internal Flow Diverters

3,267,564 Keyes, J.M.
1966 Aug. 23,
29/157.3
042A
Method Of Producing Duplex Internally Finned Tube Units

3,394,736 Pearson, J.F.
1968 July 30,
138/38
042A
Internal Finned Tube

3,422,518 French, F.W.
1969 Jan. 21,
29/157.3
042A
Method Of Reforming Tubular Metal Blanks Into Inner Finned Tubes

3,596,495 Huggins, H.D.
1971 Aug. 3,
72/367
042A
Heat Transfer Device And Method Of Making

3,636,982 Drake, C.E.
1972 Jan. 25,
138/38
042A
Internally Finned Tube And Method Of Forming Same

3,662,582 French, F.W.
1972 May 16,
72/367
042A
Heat-Exchange Tubing And Method Of Making It

3,696,863 Kim, S.C.
1972 Oct. 10,
165/179
042A
Inner-Outer Finned Heat Transfer Tubes

3,750,709 French, F.W.
1973 Aug. 7,
138/38
042A
Heat Exchanger Tube And Method Of Making It

3,776,018 French, F.W.
1973 Dec. 4,
72/367
042A
Tubing With Inner Baffle Fins And Method Of Producing It

3,846,254 Sephton, H.H.
1974 Nov.5.
203/11
042A
Interface Enhancement Applied To Evaporation of Liquids

3,887,004 Beck, T.A.
1975 June 3,
165/179
042A
Heat Exchange Apparatus

4,007,774 Withers, J.G. Jr.
1977 Feb. 15,
165/1
042A
H-X Apparatus And Method Of Controlling Fouling Therein

4,031,602 Cunningham, J.L.; and Campbell, B.J.
1977 June 28,
29/157.3AH
042A
Method Of Making Heat Transfer Tube

4,154,296 Fijas, D.F.
1979 May 15,
165/179
042A
Inner Finned Heat Exchanger Tube

4,163,474 MacDonald, R.D.; Rose, R.K.; and Papsdorf
1979 Aug. 7
165/179
042A
Internally Finned Tube

4,190,105 Dankowski, G.
1980 Feb. 26
165/179
042A
Heat Exchange Tube

4,216,575 Carnavos, T. C.; and Golymbieski, W. J.
1980 Aug. 12, Noranda Mines, Ltd.
29/597
042A
Method of Reforming the Fins of a Finned Tube

4,227,572 Harlan, C. S.
1980 Oct. 14, Seton-Scherr, Inc.
165/184
042A
Finned Tubing

4,258,782 Kao, S.S.T.
1981 Mar. 31, Modine Manufacturing Company
165/109 T
042A
Heat Exchanger Having Liquid Turbulator

4,286,655 Trojani, B.L.
1981 Sep. 1
165/179
042A
Finned Tube for Heat Exchangers

4,296,539 Asami, T.
1981 Oct. 27, Kobe Steel, Ltd.
29/157.3 A
042A
Heat Transfer Tubing for Natural Gas Evaporator

4,305,460 Yampolsky, J.S.
1981 Dec. 15, General Atomic Company
165/179
042A
Heat Transfer Tube

4,306,619 Trojani, B.L.
1981 Dec. 22
165/179
042A
Tube Provided with Inner Fins and Outer Fins or Pins, Particularly for Heat Exchangers, and Method Therefor

4,351,392 Stockman, R. F.
1982 Sep. 28, Combustion Engineering, Inc.
165/186
042A
Heat Exchange Tube with Heat Absorptive Shield

4,345,644 Dankowski, D.B.
1982 Aug. 24
165/154
042A/C
Oil Cooler

1,716,743 Still, W.J.
1929 June 11
042B
Heat Transmitting Tube

2,118,060 Stone, R.H.; and Tilley, E.F.
1938 May 24,
257/262
042B
Finned Tube

2,227,680 Townsend, A.J.; and Bascombe, F.J.
1941 Jan. 7,
257/262
042B
Finned Tubing Or The Like

2,234,423 Wittmann, R. A.
1941 Mar. 11, Thermek Corp.
122/333
042B
Heating Means

2,245,069 Clark, W.R.
1941 June 10,
257/262
042B
Heat Transfer Unit

2,247,243 Kritzer, R. W.
1941 June 24, Thermek Corp.
29/157.3
042B
Heat Exchange Element and Method of Making the Same

2,613,066 Newlin, J.S.
1952 Oct. 7,
257/262.20
042B
Finned Tube Construction

3,022,049 Abbott, R.W.
1962 Feb. 20,
257/262.13
042B
Heat Exchange Tubing

3,033,536 Guszmann, M.
1962 May 8,
257/262.16
042B
Radiator System

3,174,319 Koyama, S.; Shida, J.; and Nakayama, K.
1965 March 23,
72/96
042B
Method And Apparatus For Manufacturing Integrally Finned Tubing

3,202,212 Kritzer, R.W.
1965 Aug. 24,
165/179
042B
Heat Transfer Element

3,221,399 Karmazin, J.
1965 Dec. 7,
29/157.3
042B
Method Of Manufacturing Heat Exchanger

3,269,459 Popovitch, D.
1966 Aug. 30,
165/140
042B
Extensive Surface Heat Exchanger

3,288,209 Wall, A.J.; and Palmer, A.
1966 Nov. 29,
165/184
042B
Heat Transmitting Tubes Having Helical Fin Means

3,295,599 Okamoto, Y. ETAL
1967 Jan. 3,
165/184
042B
Heat Transfer Fin Heat Exchanging Tube

3,360,040 Kritzer, R.W.
1967 Dec. 26,
165/181
042B
Heat Exchanger Elements

3,384,165 Mathews, R.T.
1968 May 21,
165/122
042B
Heat Exchanger

3,438,433 Gunter, A.Y.
1969 April 15, Hudson Engineering
165/151
042B
Plate Fins

3,540,530 Kritzer, R.W.
1970 Nov. 17,
165/146
042B
Graduated Heat Exchanger Fins

3,595,310 Burne, F.A.
1971 July 27,
165/181
042B
Modular Units And Use Thereof In Heat Exchangers

3,603,384 Huggins, H.D.; and Dudley, C.J.
1971 Sept. 7,
165/181
042B
Expandable Tube And Heat Exchanger

3,692,105 O'Connor, J.M.
1972 Sept. 19,
165/181
042B
Heat Exchangers

3,731,732 Awe, E.C.; Burton, J.C.; and Blank, T.G.
1973 May 8,
165/181
042B
Tube And Fin Heat Exchanger

3,746,086 Pasternak, S.F.
1973 July 17,
165/181
042B
Heat Exchangers

3,752,228 Bosse, R.C.
1973 Aug. 14,
165/184
042B
I-Type Segmented Finned Tube

3,781,959 O'Connor, J.M.
1974 Jan. 1,
29/157.3B
042B
Method Of Fabricating A Finned Heat Exchange Tube

3,804,159 Searight, E.F.; and Brosens, P.J.
1974 April 16,
165/109
042B
Jet Impingement Fin Coil

3,810,509 Kun, L.C.
1974 May 14, Union Carbide Corp.
165/148
042B
Cross Flow Heat Exchanger

3,845,814 Kun, L.C.
1974 Nov. 5, Union Carbide Corp.
165/148
042B
Finned Primary Surface Heat Exchanger

3,877,517 Pasternak, S.F.
1975, April 15,
165/146
042B
Heat Exchangers

3,885,936 Limebeer, G.J.N.
1975 May 27,
62/304
042B
Heat Exchangers

3,901,312 Pasternak, S.F.
1975 Aug. 26,
165/181
042B
Heat Exchangers And Method Of Making Same

3,947,941 O'Connor, J.M.: and Pasternak, S.F.
1976 April 6,
29/157.3B
042B
Method Of Making A Heat Exchanger

3,976,126 Ruff, K.
1976 Aug. 24,
165/110
042B
Air Cooled Surface Condenser

3,983,935 Henrion, C.E.
1976 Oct. 5,
165/166
042B
Heat Exchanger

4,034,804 Meijer, R.J.; and Mulder, J.
1977 July 12, U.S. Philips Corp.
165/148
042B
Motor-Car Radiator

4,071,934 Zolman, J.O.; and Griewahn, C.O.
1978 Feb. 7,
29/157.3 A
042B
CFT Box Fin

4,095,648 Shipes, K.V.
1978 June 20,
165/162
042B
Tube Bundles

4,098,332 Bratthall, L.; and Linstrom, B.
1978 July 4,
165/172
042B
Finned Tube Heat Exchanger Construction

4,131,157 Laing, N.
1978 Dec. 26,
165/86
042B
Rotary Heat Exchangers

4,141,411 Kalnin, I.M. ETAL
1979 Feb. 27,
165/151
042B
Tubular Heat Exchanger

4,143,710 LaPorte, G.E.; Osterkorn, C.L.; and Marino, S.M.
1979 Mar. 13,
165/182
042B
Heat Transfer Fin Surface

4,180,897 Chester, D.H.
1980 Jan. 1,
29/157.3 A
042B
Method of Fabricating Honeycomb Heat Exchanger

4,300,629 Hatada, T.; Senshu, T.; Arai, A.; Harada, F.; Matsuzaki, A.; Futawatari, H.; Imaizumi, Y.; and Takeda, S.
1981 Nov. 17, Hitachi, Ltd.
165/151
042B
Cross-Fin Tube Type Heat Exchanger

4,300,630 Trojani, B.L.
1981 Nov. 17
165/181
042B
Finned Metal Tube and Method for Making the Same

4,311,193 Verhaeghe, R.C.; and Huggins, H.D.
1982 Jan. 19, Modine Manufacturing Company
165/149
042B
Serpentine Fin Heat Exchanger

4,328,861 Cheong, A.S.; and Beldam, R.P.
1982 May 11, Borg-Warner Corporation
165/151
042B
Louvred Fins for Heat Exchangers

4,332,291 Mulock-Bentley, D.
1982 Jun. 1, D. Mulock-Bentley and Associates
165/76
042B
Heat Exchanger with Slotted Fin Strips

4,332,293 Hiramatsu, M.
1982 Jun. 1, Nippondenso Co., Ltd.
165/153
042B
Corrugated Fin Type Heat Exchanger

4,368,776 Negita, J.; Yamada, Y.; Kaneko, H.; Ogino, T.
1983 Jan. 18, Nippondenso Co., Ltd.
165/133
042B
Aluminum Heat Exchanger

4,368,777 Grasso, G.
1983 Jan. 18, Centro Ricerche Fiat S.p.A.
165/154
042B
Gas-Liquid Heat Exchanger

4,369,837 Moranne, J.-P.
1983 Jan. 25, Societe Anonyme des Usines Chausson
165/175
042B
Tube for Tube-Plate Heat Exchangers

4,373,577 McMillen, R.G.
1983 Feb. 15, International Harvester Co.
165/122
042B
Heat Exchanger Assembly

4,373,578 Saperstein, Z.P.; El-Bourini, R.M.; and Munch, J.E.
1983 Feb. 15, Modine Manufacturing Company
165/141
042B
Radiator with Heat Exchanger

4,375,832 Asselman, G.A.; Casteligns, A.P.J.; and Van Mensvoort, A.J.
1983 Mar. 8, U.S. Philips Corp.
165/152
042B
Tube and Fin Radiator

2,244,809 Pascale, M.
1941 June 10,
257/262
042C
Heat Transfer Tube

2,247,243 Kritzer, R.W.
1941 June 24
29/157.3
042C
Heat Exchange Element and Method of Making the Same

2,463,997 Rodgers, J.S.
1949 March 8,
29/157.3
042C
Method Of Making Externally And Internally Finned Tubes

2,553,142 McCreary, K.
1951 May 15,
29/157.3
042C
Method For Making Heat Exchangers

2,870,999 Soderstrom, S.H.
1959 Jan. 27,
257/262.20
042C
Heat Exchange Element

2,905,447 Huet, A.
1959 Sept. 22,
257/262.14
042C
Tubular Heat Exchanger

2,978,797 Ekelund, A.F.
1961 April 11,
29/157.3
042C
Tubular Finned Metal Section And Manufacture Thereof

2,998,228 Huet, A.
1961 Aug. 29,
257/262.18
042C
Surface Heat Exchangers

3,111,168 Huet, A.
1963 Nov. 19,
165/165
042C
Heat Exchangers

3,128,821 Andersen, E. C.
1964 Apr. 14, Flexonics Corp.
153/71
042C
Corrugator for Metal Tubing

3,215,196 Pauls, T.F.
1965 Nov. 2,
165/179
042C
Metal Fabrication

3,289,756 Jaeger, U.R.
1966 Dec. 6, Olin Mathieson Chemical Corporation
165/155
042C
Heat Exchanger

3,294,162 Loehlein, H.J.; and Curran, E.E.
1966 Dec. 27,
165/181
042C
Heat Exchanger Construction And Method For Making The Same

3,602,027 Kluq, W.A.; and Ware, C.D.
1971 Aug. 31, The Trane Company
72/90
042C
Simultaneous Finning and Reforming of Tubular Heat Transfer Surface

3,856,079 Geppelt, E.W.
1974 Dec. 24,
165/184
042C
Finned Tube Heat Exchange Conductor

4,031,602 Cunningham, J.L.; and Campbell, B.J.
1977 June 28,
29/157.3AH
042C
Method Of making Heat Transfer Tube

4,065,264 Lewin, J.E.
1977 Dec 27,
23/258.5BH
042C
Blood Oxygenator With Integral H-X For Regulating etc.

4,086,959 Habdas, E.P.
1978 May 2,
165/155
042C
Automotive Oil Cooler

4,171,015 Bucey, C.W.; Miller, K.J.; and Robinson, R.R.
1979 Oct. 16
165/181
042C
Heat Exchanger Tube and Method of Making Same

4,317,268 Bowden, D.R.; and Novell, B.J.
1982 Mar. 2, Solar Limited, Inc.
29/157.3 AH
042C
Process for Making a Heater Exchanger

4,360,059 Funke, K.-H.
1982 Nov. 23, Funke Warmeaustauscher Apparatebau KG
165/160
042C
Tube Type Heat Exchanger

2,985,434 Boring, S.A.;Speca, E.J.; and Zierak, S.J.
1961 May 23,
257/245
042D
Regenerator

3,850,234 Fowler, G.
1974 Nov. 26,
165/153
042D
Heat Exchangers

2,789,797 Simpelaar, C.S.
1957 April 23,
257/245
042E
Heat Exchanger Fin Structure

2,877,000 Person, F.W.
1959 March 10,
257/245
042E
Heat Exchanger

2,892,618 Holm, S.
1959 June 30,
257/245
042E
H-X And Cores And Extended Surface Elements Therefor

3,187,812 Staver, E.F.
1965 June 8,
165/185
042E
Heat Dissipator For Electronic Circuitry

3,209,062 Scholz, C.F.
1965 Sept. 28,
174/15
042E
Mounting And Cooling Syst. For Semi-Conductor Heat Generating Dev.

3,363,682 Hartley, D.E.
1968 Jan. 16,
165/181
042E
Heat Exchangers Having Vortex Producing Vanes

3,818,984 Nakamura, K.; and Kuroyanagi, M.
1974 June 25,
165/166
042E
Heat Exchanger

4,029,146 Hart, W.F.; and Koenig, R.A.
1977 June 14,
165/166
042E
Corrugated Sheet Heat Exchanger

4,163,474 MacDonald, R.D.; Rose, R.K.; and Papsdorf
1979 Aug. 7
165/179
042E
Internally Finned Tube

4,171,015 Bucey, C.W.; Miller, K.J.; and Robinson, R.R.
1979 Oct. 16
165/181
042E
Heat Exchanger Tube and Method of Making Same

4,180,897 Chester, D.H.
1980 Jan. 1
29/157.3A
042E
Method of Fabricating Honeycomb Heat Exchanger

4,337,826 Kritzer, R.W.
1982 Jul. 6, Peerless of America, Inc.
165/151
042E
Heat Exchangers and Method of Making Same

4,346,760 Vidal-Meza, G.D.
1982 Aug. 31, Caterpillar Tractor Co.
165/166
042E
Heat Exchanger Plate Having Distortion Resistant Uniform Pleats

4,368,779 Rojey, A.; and Cohen, G.
1983 Jan. 18, Institut Francais du Petrole
165/165
042E
Compact Heat Exchanger

3,117,625 Fraenkel, S.J.
1964 Jan. 14, Stanray Corp.
165/185
042P
Filling Material for Heat Exchangers

3,163,207 Schultz, R.T.
1964 Dec. 29,
165/68
042F
Heat Dissipating Mount For Electronic Components

4,374,542 Bradley, J.C.
1983 Feb. 22,
165/166
042F
Undulating Prismoid Modules

2,958,021 Cornelison, B.; and Wolff, E.A. Jr.
1960 Oct. 25,
317/234
043A
Cooling Arrangement For Transistors

2,960,114 Hinde, J.N.
1960 Nov. 15,
138/38
043A
Innerfinned Heat Transfer Tubes

3,088,494 Koch, P.H.; Pirsh, E.A.; and Swenson, H.S.
1963 May 7,
138/37
043A
Ribbed Vapor Generating Tubes

3,339,631 McGurty, J.A.; and Necker, W.C.
1967 Sept. 5,
165/109
043A
Heat Exchanger Utilizing Vortex Flow

3,871,407 Bykov, A.V. ETAL
1975 March 18,
138/38
043A
Heat Exchange Apparatus

4,118,944 Lord, R.G.; Bussjager, R.C.; and Geary, D.P.
1978 Oct. 10,
62/98
043A
High Performance Heat Exchanger

3,299,949 Beurtheret, C.A.E.
1967 Jan. 24,
165/185
043C
Device For Evaporative Cooling Of Bodies And Power Vacuum etc.

3,326,283 Ware, C.D.
1967 June 29,
165/181
043C
Heat Transfer Surface

3,521,708 Webb, R.L.
1970 July 28,
165/186
043C
Heat Transfer Surface Which Promotes Nucleate Ebullition

3,696,861 Webb, R.L.
1972 Oct. 10,
165/133
043C
Heat Transfer Surface Having A High Boiling H.T. Cofficient

3,768,290 Zatell, V.A.
1973 Oct. 30,
72/68
043C
Method Of Modifying A Finned Tube For Boiling Enhancement

3,881,342 Thorne, J.K.
1975 May 6,
72/68
043C
Method For Making Integral Finned Tubes For Submerged Boiling

4,040,479 Campbell, B.J.; and Rieger, K.R.
1977 Aug. 9,
165/133
043C
Finned Tube Having Enhanced Nucleate Boiling Surface

4,059,147 Thorne, J.K.
1977 Nov. 22,
165/133
043C
Integral Finnod Tube For Submerged Boiling Applications etc.

4,074,753 Schmittle, K.V.; and Starner, K.E.
1978 Feb. 21,
165/184
043C
Heat Transfer In Pool Boiling

4,159,739 Brothers, W.S.; and Kallfelz, A.J.
1979 July 3
165/133
043C
Heat Transfer Surface and Method of Manufacture

4,159,735 Anderson, J.H.
1979 July 3
165/40
043D
Plate-Fin Heat Exchanger With Controls Therefor

3,455,376 Beurtheret, C.A.E.
1969 July 15,
165/1
043E
Heat Exchanger

4,159,735 Anderson, J.H.
1979 July 3
165/40
043E
Plate-Fin Heat Exchanger With Controls Therefor

2,935,306 Beutheret, C. A. E.
1960 May 3, General Electric Company
257/250
043F
Vapor Cooling Apparatus for Electric Discharge Devices

2,969,957 Beurtheret, C. A. E.
1961 Jan. 31, Compagnie Francaise Thomson-Houston
257/250
043F
Electric Discharge Device Cooling Systems

3,046,428 Beurtheret, C. A. E.
1962 July 24, Compagnie Francaise Thomson-Houston
313/12
043F
High Frequency Energy Interchange Device

3,046,429 Beurtheret, C. A. E.
1962 July 24, Compagnie Francaise Thomson-Houston
313/12
043F
High Frequency Energy Interchange Device

3,089,318 Hebeler, H.K.
1963 May 14,
62/467
043F
Hypersonic Cooling System

3,235,004 Beurtheret, C.
1966 Feb. 15, Compagnie Francaise Thomson-Houston
165/185
043F
Heat Dissipating Structure

3,306,350 Beurtheret, C.A.E.
1967 Feb. 28, Compagnie Francise Thomson Houston-Hotchkiss Brandt
165/105
043F
Electron Discharge Tube Having Improved Cooling Means Therefor

3,367,415 Beurtheret, C.A.E.
1968 Feb. 6, Compagnie Francaise Thomson Houston-Hotchkiss Brandt
165/185
043F
Anisotherm Evaporation Heat-Transfer Structure

3,384,160 Beurtheret, C.A.
1968 May 21, Compagnie Francaise Thomson Houston-Hotchkiss Brandt
165/74
043F
Non-Isothermal Evaporation Type Heat Transfer Apparatus

3,390,667 Beutheret, C. A. E.
1968 July 2, Compagnie Francaise Thomson Houston-Hotchkiss Brandt
123/8
043F
Two-Stage Cooling System for Heat Machine Components

4,284,133 Gianni, S.J.; and Seeley, W.M.
1981 Aug. 18, Dunham-Bush, Inc.
165/133
044A
Concentric Tube Heat Exchange Assembly with Improved Internal Fin Structure

4,367,791 Asami, T.
1983 Jan. 11, Kobe Steel Ltd.
165/109
044A/B
Heat Transfer Tubing for Natural Gas Evaporator

3,273,599 Heeren, H.
1966 Sep. 20
130/30
045A
Internally Finned Condenser Tube

3,457,990 Theophilous, N.P.; and Wang, D.I.J.
1969 July 29,
165/133
045A
Multiple Passage Heat Exchanger Utilizing Nucleate Boiling

3,528,494 Levedahl, W.J.
1970 Sept. 15,
165/105
045A
Heat Pipe For Low Thermal Conductivity Working Fluids

3,175,960 Kassat, H.
1965 March 30,
202/189
045B
Air Cooled Condenser For Distilling Apparatus

4,166,498 Fujie, K. ETAL
1979 Sep, 4
165/133
045B
Vapor-Condensing, Heat-Transfer Wall

2,241,209 Lea, E.S.
1941 May 6,
257/236
045C
Finned Condenser Tube

2,983,115 Caswell, H.E.
1961 May 9,
62/285
045C
Heat Transfer Device With Condensate Drainage Means

3,450,193 Wolfe, W. Jr.
1969 June 17,
165/1
045C
Corrugated Tubing

3,481,394 Withers, J.G. Jr.
1969 Dec. 2,
165/179
045C
Configuration Of H.T. Tubing For Vapour Condensation etc.

3,559,437 Withers, Jr., J.G.
1971, Feb. 2
72/96
045C
Method and Apparatus for Making Heat Transfer Tubing

4,330,036 Satoh, Y; and Higo, T.
1982 May 18, Kobe Steel, Ltd.
165/179
045C
Construction of a Heat Transfer Wall and Heat Transfer Pipe and Method of Producing Heat Transfer Pipe

2,813,701 Fenger, C.
1957 Nov. 19,
257/245
045E
Cross Flow Heat Exchanger

3,225,824 Wartenberg, K.
1965 Dec. 28,
165/122
045E
Air Cooled Heat Exchanger For Cooling Liquid Media

2,947,152 Bloem, A.T.
1960 Aug. 2,
62/40
045F
H-X For Seperating Out Constituents From A Gas By Cooling

4,141,409 Woodhull,I.D.Jr.; and Liedel, T.H.
1979 Feb. 27,
165/110
045F
Condenser Header Construction

4,366,859 Keyes, J.M.
1983 Jan. 4,
165/184
046F
Refractory Heat Exchange Tube

4,374,542 Bradley, J.C.
1983 Feb. 22,
165/166
046F
Undulating Prismoid Modules

3,886,976 Kardas, A.; Larson, D.H.; and Nesbitt, J.D.
1975 June 3,
138/38
052A
Recuperator Having A Reradiant Insert

3,921,711 Westbrock, A.J.
1975 Nov. 25,
165/109
052A
Turbulator

4,194,560 Matsuzaki, Y.
1980 Mar. 25, Nihon Radiator Co., Ltd.
165/141
052A
Oil Cooler and Method for Forming It

1,931,268 Philipp, L.A.
1933 Oct. 17,
62/126
054A
Refrigerating System

4,186,798 Tseluiko, J.I.; Kutsykovich, D.B.; Shabelnikova, L.A., Kholopov, V., Schekin, N.G., Gritsuk, L.D., Katsenelenbogen, L.B.
1980 Feb. 5
165/147
054A
Tubular Cooled Members of Metallurgical Furnace

2,729,266 Humphrey, R. P.
1956 Jan. 3; General Gas Light Company
153/71
062A
Apparatus and Method for Making Spirally Corrugated Metal Tubes

3,213,525 Creighton, W.M.; Evans, S.O.; and McMurdy, A.E.
1965 Oct. 26,
29/157.3
062A
Method of Forming An Internal Rib In The Bore Of A Tube

3,533,267 Bunnell, T. R.
1970 Oct. 13, Turbotec, Inc.
72/299
062A
Method and Machine for Spirally Corrugating Tubes

3,730,229 D'Onofrio, M. L.
1973 May 1, Turbotec, Inc.
138/114
062A
Tubing Unit with Helically Corrugated Tube and Method for Making Same

3,777,343 Hartford, M. L. D.
1973 Dec. 11, Spiral Tubing Corp.
29/157.3 R
062A
Method for Forming a Helically Corrugated Concentric Tubing Unit

4,314,606 Muller, W.; Gauer, R.; Walkenhorst, W.; and Wild, G.
1982 Feb. 9, Hoechst Aktiengesellschaft
165/163
062C
Apparatus for a Treatment of Flowing Media Which Causes Heat Exchange and Mixing

3,228,464 Stein, W.J.; and Banthin, C.R.
1966 Jan. 11,
165/166
062D
Corrugated Plate Counter Flow Heat Exchanger

2,610,835 Hytte, R.P.L.
1952 Sept. 16,
257/245
062D
Plate Heat Exchanger

2,617,634 Jendrassik, G.
1952 Nov. 11,
257/245
062D
Heat Exchanger

2,623,736 Hytte, R.P.L.
1952 Dec. 30,
257/245
062D
Plate Type Pasteurizer

2,872,165 Wennerberg, F.J.
1959 Feb. 3,
257/245
062D
Plate Type Heat Exchangers

2,932,491 Miller, L.M.
1960 April 12,
257/256
062D
Heat Transfer Unit

2,952,444 Jenssen, S.K.
1960 Sept. 13,
257/245
062D
Heat Exchangers Of The Plate Type

2,995,344 Hryniszak, W.
1961 Aug. 8,
257/245
062D
Plate Type Heat Exchanger

3,207,216 Donaldson, D.M.
1965 Sept. 21,
165/148
062D
Heat Exchanger

3,311,165 Karmazin, J.
1967 March 28,
165/109
062D
Heat Exchanger

3,469,626 Wright, F.W.; and Wilson, A.H.
1969 Sept. 30,
165/166
062D
Plate Heat Exchangers

3,532,161 Lockel, F.A.
1970 Oct. 6,
165/167
062D
Plate Type Heat Exchanger

3,559,722 Schauls, J.L.; and Duncan, F.D.
1971 Feb. 2,
159/16
062D
Method And Apparatus For Two Phase H.X. Fluid Distribution etc.

3,590,917 Huber, J.; and Poth, L.
1971 July 6,
165/167
062D
Plate Type Heat Exchanger

3,608,629 Cowans, K.W.
1971 Sept. 28,
165/165
062D
Flow Compensator For Exchanger Apparatus

3,650,321 Kaltz, K.L.
1972 March 21,
165/106
062D
Sheet Metal Radiator Assembly

3,669,186 Schauls, J.J.
1972 June 13,
165/166
062D
Distributor For Plate Type Heat Exchangers Having End Headers

3,757,856 Kun, L.C.
1973 Sept. 11,
165/166
062D
Primary Surface Heat Exchanger And Manufacture Thereof

3,759,322 Nasser, G.E.D.; and Waldmann, H.
1973 Sept. 18,
165/166
062D
Heat Exchanger

3,759,323 Dawson, H.J. ETAL
1973 Sept. 18,
165/166
062D
C-Flow Stacked Plate Heat Exchanger

3,807,496 Stadmark, N.H.G.
1974 April 30,
165/167
062D
Heat Exchange Plates

3,827,343 Darm, W.J.
1974 Aug. 6,
98/115
062D
Grease Collecting Heat Exchanger Installation

3,831,664 Pogson, J.T.
1974 Aug. 27,
165/80
062D
Heat Pipe Interfaces

3,862,661 Kovalenko, L.M. ETAL
1975 Jan. 28,
165/166
062D
Corrugated Plate For H-X And H-X With Said Etc.

3,931,854 Ivakhnenko, V.V. ETAL
1976 Jan. 13,
165/166
062D
Plate Type Heat-Exchange Apparatus

3,983,191 Schauls, J.J.
1976 Sept. 28,
261/114R
062D
Brazed Plate Type H-X For Nonadiabatic Rectification

3,995,688 Darm, W.J.
1976 Dec. 7,
165/165
062D
Air To Air Heat Exchanger

4,002,201 Donaldson, D.M.
1977 Jan. 11,
165/140
062D
Multiple Fluid Stacked Plate Heat Exchanger

4,016,928 Bartels, E.L.; and Fleming, R.B.
1977 April 12,
165/141
062D
Heat Exchanger Core Having Expanded Metal Heat Transfer Surfaces

4,073,340 Parker, K.O.
1978 Feb. 14,
165/166
062D
Formed Plate Type Heat Exchanger

4,108,242 Searight, E.F.; and Flanagan, P.
1978 Aug. 22,
165/164
062D
Jet Impingement Heat Exchanger

4,109,710 Forster, S.; and Kleemann, F.
1978 Aug. 29,
165/165
062D
Heat Exchanger

4,109,711 Kleine, C.A.; and Middleton, V.L.
1978 Aug. 29,
165/170
062D
Heat Exchange Panel

4,120,351 Kleine, C.A.; and Middleton, V.L.
1978 Oct. 17,
165/170
062D
Heat Exchange Panel With Improved Header

4,128,125 Borjesson, L.R.; and Johansson, L.A.
1978, Dec. 5,
165/163
062D
Spiral Heat Exchanger

4,131,159 Long, W.A.
1978 Dec. 26,
165/166
062D
Heat Exchanger

4,133,377 Lallee, de.J.; Marie, G; and Moracchioli, R.
1979 Jan. 9,
165/118
062D
Thin-Film Heat Exchanger

4,146,090 Nakayama, Y.; and Komana, N.
1979 Mar. 27,
165/166
062D
Plate Type Heat Exchanger

4,162,703 Bosaeus, J.A.
1979 July 31
165/167
062D
Plate-Type Heat Exchanger

4,176,713 Fisher, H.
1979 Dec. 4
165/166
062D
Plate-Type Heat Exchanger

4,183,403 Nicholson, T.P.
1980 Jan. 15
165/166
062D
Plate Type Heat Exchangers

4,313,494 Bengtsson, F.
1982 Feb. 2, Carl Johan Lockmans Ingenjorsbyra
165/148
062D
Plate Heat Exchanger

3,860,065 Schauls, J.J.
1975 Jan. 14,
165/166
062E
Distributor For Plate Type Heat Exchanger Having Side Headers

4,144,933 Asselman, G.A.A.; and Castelijns, A.P.J.
1979 Mar 20,
165/124
062E
Heat Exchanger

4,148,357 Forster, S.; and Kleemann, M.
1979 April 10,
165/140
062E
Heat Exchanger Matrix for Recuporative Heat Exchange etc.

4,223,723 Hilal, M.A.
1980 Sep. 23, Wisconsin Alumni Research Foundation
165/133
063F
Heat Transfer in Boiling Liquified Gas

3,240,683 Rogers, F.A.
1966 March 15,
202/173
065D
Distillation Apparatus For Treating Sea Water To Produce etc.

3,371,709 Rosenblad, C.F.
1968 March 5,
165/115
065D
Falling Film Plate Heat Exchanger

3,759,050 Slaasted, R.S.; and Dudley, J.C.
1973 Sept. 18,
62/93
065D
Method Of Cooling A Gas And Removing Moisture Therefrom

4,139,054 Anderson, J.H.
1979 Feb. 13,
165/76
065D
Plate Fin Heat Exchanger

4,180,129 Sumitomo, H.
1979 Dec. 25, Hisaka Works, Ltd.
165/110
065D
Plate Type Condenser

4,182,410 Yoshida, K.; Kobayashi, K.; and Sumitomo, H.
1980 Jan 8, Hisaka Works Ltd.
165/110
065D
Plate Type Condenser

4,182,411 Sumitomo, H.; Fukami, K;, Kobayashi, K.; Doi, M., Kawanishi, K. and Yoshida, K.
1980 Jan. 8, Hisaka Works Ltd.
165/110
065D
Plate Type Condenser

4,184,542 Sumitomo, H.
1980 Jan. 22, Hisaka Works, Ltd.
165/166
065D
Plate Type Condenser

4,228,850 Sumitomo, H.
1980 Oct. 21, Hisaka Works, Ltd.
165/110
065D
Plate Used in Condenser

4,230,179 Uehara, H.; and Miyoshi, M.
1980 Oct. 28, Haruo Uehara; Tokyo Shibaura Denki Kabushiki Kaisha
165/113
065D
Plate Type Condensers

4,285,395 Masutani, K.; Horiguchi, A.; and Sumitomo, H.
1981 Aug 25
165/110
065D
Structure of Fluid Condensing and Heat Conducting surface of Condenser

1,770,208 Kemnal, J.
1930 July 8,
072A
Air Heater

1,916,337 Schmidt, W.A.
1933 July 4,
072A
Heat Interchanging Apparatus

2,097,104 Saha, A.P.
1937 Oct. 26,
257/248
072A
Heat Exchange Apparatus

2,161,887 Ramsaur, W.R.
1939 June 13,
138/38
072A
Turbulence Strip For Radiator Tubes

3,071,159 Coraggioso, C.B.
1963 Jan. 1,
138/38
072A
Heat Exchange Tube

3,407,871 Penney, W.R.
1968 Oct.29,
165/85
072A
Heat Exchanger

3,605,872 Brault, J.
1971 Sept. 20,
165/1
072A
Method Causing Liquid To Flow In Stream Of Annular Cross Section

3,783,938 Chartet, A.
1974 Jan. 8,
165/166
072A
Disturbing Device And Heat Exchanger Embodying The Same

3,870,081 Kleppe, B.; and Torgersen, O.
1975 March 11,
138/38
072A
Heat Exchange Conduit

4,044,796 Smick, R.H.
1977 Aug. 30,
138/38
072A
Turbulator

4,090,559 Megerlin, F.E.
1978 May 23,
165/179
072A
Heat Transfer Device

4,336,838 Ely, R.J.
1982 Jun. 29,
165/109 T
072A
Heat Exchange Turbulator

2,360,094 Arvins, N.A.; and Arvintz, A.A.
1944 Oct. 10,
257/233
072F
Heat Exchanger

3,747,670 Palm, L.J.; and Palm, R.B.
1973 July 24,
165/1
072F
Thermal Fluid Heater

3,055,643 Beurtheret, C.A.E.
1962 Sept. 25,
257/250
073A
Heat Exchangers

2,517,654 Gaugler, R.S.
1950 Aug. 8,
261/99
073F
Refrigerating Apparatus

2,950,604 Gambill, W.R.; and Greene, N.D.
1960 Aug. 30,
62/5
074A
Heat Transfer Method

3,423,294 Sephton, H.H.
1969 June 21,
203/10
074A
Vortex Flow Film Distillation Process

3,648,754 Sephton, H.H.
1972 March 14,
153/13A
074A
Vortex Flow For Enhancing Interfacial Surface & Heat & Mass Transf

3,232,341 Woodworth, L.R.
1966 Feb. 1,
165/111
075A
Condenser

3,675,710 Ristow, R.E.
1972 July 11,
165/1
075A
High Efficiency Vapor Condenser and Method

3,457,982 Sephton, H. H.
1969 July 29,
159/13
076A
Evaporation and Distillation Apparatus

4,130,902 Mackenroth, J.P. III; and Bode, H.B.
1978 Dec. 26,
2/7
081F
Cooling Hatband

4,124,061 Mitchell, R.C. ETAL
1978 Nov. 7,
165/1
082F
Thermal Energy Storage Unit

3,604,504 Kessler, S.W. Jr.; and Hess, J.L.
1971 Sept. 14,
165/105
083A
Flexible Heat Pipe

3,665,573 Werner, R.W.; Alexander, E.E.; and Comstock, I.J.
1972 May 30,
29/157.3
083A
Method Of Fabricating A Heat Pipe

3,892,273 Nelson, B.E.
1975 July 1,
165/105
083A
Heat Pipe Lobar Wicking Arrangment

3,598,180 Moore, R.D. Jr.
1971 Aug. 10,
165/133
083C
Heat Transfer Surface Structure

2,517,654 Gaugler, R.S.
1950 Aug. 8,
261/99
083F
Refrigerating Apparatus

3,152,774 Wyatt, T.
1964 Oct. 13,
244/1
083F
Satellite Temperature Stabilization System

3,229,759 Grover, G.M.
1966 Jan. 18,
165/105
083F
Evaporation-Condensation Heat Transfer Device

3,840,069 Fischer, W.; and Gammel, G.
1974 Oct. 8,
165/105
084A
Heat Pipe With A Sintered Capillary Structure

4,353,415 Klaschka, J. T.; and Davies, M. J.
1982 Oct. 12, United Kingdom Atomic Energy Authority
165/104.21
084A
Heat Pipes and Thermal Siphons

3,762,468 Newson, I.H.; and Hodgson, T.d.
1973 Oct.2,
165/177
084B
Heat Transfer Members

2,970,669 Bergson, G.
1961 Feb. 7,
183/2
085A
Condensing Filter

3,837,396 Newton, A.B.
1974 Sept. 24,
165/111
085A
Vertical Surface Vapor Condensers

3,846,254 Sephton, H.H.
1974 Nov. 5,
203/11
085A
Interface Enhancement Applied To Evaporation Of Liquids

3,903,962 Newton, A.B.
1975 Sept. 9,
165/110
085A
Condensate Guiding Apparatus For Vertical Condensing Tubes etc.

3,989,104 Newton, A.B.
1976 Nov. 2,
165/111
085A
Condenser Inserts

3,762,468 Newson, I.H.; and Hodgson, T.D.
1973 Oct. 2,
165/177
085B
Heat Transfer Members

3,508,608 Roe, R.C.
1970 April 28,
165/179
085C
Condenser Tubes

3,613,779 Brown, C.E.
1971 Oct. 19,
165/133
085C
Apparatus For Obtaining High Heat Transfer In Falling Water Film

4,305,460 Yampolsky, J.S.
1981 Dec. 15, General Atomic Company
165/179
085C
Heat Transfer Tube

4,237,970 Uehara, H.; and Miyoshi, M.
1980 Dec. 9, Haruo Uehara; Denki Kabushiki Kaisha
165/110
085D
Plate Type Condensers

4,314,605 Sumitomo, H.; Doi, M.; Kobayashi, K.; Fukami, K.; and Kawanishi, K.
1982 Feb. 9, Hisaka Works, Ltd.
165/110
085D
Condenser

3,152,774 Wyatt, T.
1964 Oct. 13,
244/1
085F
Satellite Temperature Stabilization System

3,229,759 Grover, G.M.
1966 Jan. 18,
165/105
085F
Evaporation-Condensation Heat Transfer Device

4,109,709 Honda, I; Takasu, S; and Onuki, Y.
1978 Aug. 29
165/105
085F
Heat Pipes, Process and Apparatus for Manufacturing Same

4,223,539 Webb, R.L.; and Mouqin, L.J.
1980 Sep. 23, The Trane Company
62/476
086C
Apparatus for Absorbing a Vapor in a Liquid and Absorption Refrigeration System Incorporating Same

3,534,555 Webb, J.E.
1970 Oct. 20,
60/217
092A
Laminar Flow Enhancement

3,621,905 Hedstrom, B.
1971 Nov. 23,
165/1
094A
Method Of Improving The H.T. In A Tube Of An Evaporrator etc.

3,452,147 Narbut, P.; and Moore, C.L.
1969 June 24,
174/16
101F
Noncondensable Gas - Condensable Vapor Cooled Electri. Transformer

1,916,337 Schmidt, W.A.
1933 July 4,
102A
Heat Interchanging Apparatus

3,878,885 Deronzier, J.C. ETAL
1975 April 22,
165/1
105A
Method For Causing Condensation In Drops On H-X Tubes

3,878,885 Deronzier, J.C. ETAL
1975 April 22,
165/1
105B
Method For Causing Condensation In Drops On Heat Exchanger Tubes

3,547,185 Eissenberg, D.M.
1970 Dec. 15,
165/1
105C
Method For Promoting Dropwise Condensation On Copper etc.

1,838,043 Sherwood, T.K.
1931 Dec. 22,
112F
Apparatus And Method For Heat Exchangers

2,439,775 Kennedy, W.W.
1948 April 13,
257/259
112
Heat Exchanger

3,347,059 Laing, N.
1967 Oct. 17,
62/325
112
Heat Pump

3,502,137 Pawlowski, J.
1970 March 24,
165/1
112.
Method Of Intensifying H.T. In Worms Having A Single Spiudle

3,844,341 Bimshas, J. Jr.; and Hickey, E.S.
1974 Oct. 29,
165/86
112
Rotatable Finned Heat Exchanger Device

3,955,617 Walsh, J.C.
1976 May 11,
165/94
112
Swept Surface Heat Exchanger With Dual Heat Exchange Media

3,973,623 Sarll, P.G.
1976 Aug. 10,
165/94
112
Heat Exchange Apparatus

4,072,182 Cheng, D.Y.
1978 Feb. 7,
165/1
112
Pressure Staged Heat Exchanger

4,094,165 Sisk, F.J.
1978,June 13,
62/115
112
Loss Heat Suppression Apparatus And Method For Heat Pump

4,094,170 Kantor, F.W.
1978 June 13,
62/499
112
Rotary Thermodynamic Apparatus

4,121,654 Stockman, R.F.
1978 Oct. 24,
165/6
112
Dry Cooling Tower

4,126,177 Smith, R.L.; and Yann, C.C.
1978 Nov. 21,
165/91
112
Dual Scraped Surface Heat Exchanger

4,133,375 Ducasse, J.C.V.; and Bouvet, J.
1979 Jan. 9,
165/92
112
Vertical Heat Exchanger

3,410,533 Penney, W.R.
1968 Nov. 12,
259/9
112A
Mixing Equipment

4,369,835 Goudy, P.R., Jr.
1983 Jan. 25, B.J. Landis, K.J. Landis, P.R. Goudy, Jr.
165/154
112A
Thermal Energy Transfer Apparatus and Method

3,156,455 Boulet, C.
1964 Nov. 10, Holo-Flite Intl. Inc.
263/21
112B
Methods of Effecting Heat Exchange and Heat Transfer Devices Therefor

3,529,661 Tousch, T.
1970 Sept. 22,
165/87
112B
Rotary Material Processor with Hollow Material Contacting Elements

3,724,094 Appel, D.W.; and Hong, S.H.
1973 Apr. 3, Kimberly-Clark Corp.
34/124
112B
Rotary Drying Drum

4,184,540 Myreen, B.
1980 Jan. 22, HA-Shipping Ltd.
165/92
112B
Rotary Heat Exchanger

2,731,241 Christian, J. D.
1956 Jan 17,
257/79
112C
Heat Exchange Device

2,733,898 Christian, J. D.
1956 Feb. 7,
257/101
112C
Hollow Screw Conveyor Flight

2,753,159 Christian, J. D.
1956 July 3, Holo-Flite Inc.
257/79
112C
Heat Transfer Device

2,916,807 Christian, J. D.
1959 Dec. 15,
29/156.8
112C
Heat Exchange Equipment

2,917,284 Christian, J. D.
1959 Dec. 15,
257/112
112C
Heat Exchange Apparatus

3,687,434 Dyskin, E.M. ETAL
1972 Aug. 29,
266/24
113A
Hollow Tyre Of Rotary Furnaces & Method Of Equalizing Tyre Temp.

3,814,172 Shore, D.T.
1974 June 4,
165/12
122D
Heat Exchangers

2,514,797 Robinson, R.S.
1950 July 11,
257/73
132A
Heat Exchanger

2,664,274 Worn, G.A.; and Bubin, F.L.
1953, Dec. 29,
257/73
132A
Method And Apparatus Employing Sonic Waves In Heat Exchange

3,368,610 Kartluke, H.; and Boyd, C.A.
1968 Feb. 13,
165/1
133F
Superheating Prevention And Boiling Control

3,224,485 Blomgren, O.C. Sr. ETAL
1965 Dec. 21,
158/1
141A
Heat Control Device And Method

1,980,821 Palueff, K.K.
1934 Nov. 13,
175/265
141F
Means For Cooling Electrical Apparatus

2,604,936 Kaehni, W.L.; and Kaehni, F.J.
1952 July 29,
158/113
141F
Method And Apparatus For Controlling the Generation Of Heat

3,137,184 Meyers, P.G.
1964 June 16,
77/55
141F
Tool Cooling Apparatus

3,224,497 Blomgren, O.C. Sr. ETAL
1965 Dec. 21,
165/2
141F
Method And Apparatus For Lowering The Temperature Of A Heated Body

3,670,606 Blomgren, O.C. Sr.; and Blomgren, O.C. Jr.
1972 June 20,
82/1 C
141F
Method & Apparatus For Cooling Workpiece And/Or The Cutting etc.

3,735,175 Blomgren, O.C. Jr.
1973 May 22,
313/60
141F
Method For Removing Heat From Within A Vacuum And From etc.

2,605,377 Kaehni, W.L.; and Kaehni, F.J.
1952 July 29,
219/19
142A
Heat Exchange Method And Apparatus

3,370,644 Daily, W.B.; and Speca, E.J.
1968 Feb. 27,
165/1
142A
Method Of Increasing The Rate Of Heat Transfer

1,835,557 Burke, S.P.
1931 Dec. 8,
142F
Heat Transfer

2,935,305 Beurtheret, C.A.E.
1960 May 3,
257/250
142F
Electric Discharge Device Cooling System

3,056,587 Steigerwald, K.H.
1962 Oct. 2,
257/1
142F
Methods Of Effecting A High Rate Of H.T. From A Heated Surf. etc.

3,224,497 Blomgren, O.C. Sr. ETAL
1965 Dec. 21,
165/2
142F
Method And Apparatus For Lowering The Temperature Of A Heated Body

3,448,791 Clark, J.
1969 June 10,
165/1
142F
Methods And Apparatuses For Energy Transfer

3,526,268 Robinson, M.
1970 Sept. 1,
165/1
142F
Corona Discharge Heat Transfer

3,747,284 Lyczko, F.J.
1973 July 24,
51/267
142F
Cooling Apparatus

3,872,917 Blomgren, O.C. Sr.; and Blomgren, O.C. Jr.
1975 March 25,
165/1
142F
Cooling Apparatus And Method For Heat Exchangers

2,962,265 Van Luik, Jr., F.W.
1960 Nov. 29,
257/43
145B
Vapor-Liquid Phase Conversion

2,962,265 VanLuik, F.W. Jr.
1960 Nov. 29,
257/43
145C
Vapor-Liquid Phase Conversion

2,790,310 Green, F.H.
1957 April 30,
62/136
152
Axial Flow Vortex Tube Mechanism

3,916,984 Properzi, I.
1975 Nov. 4,
164/278
152
Cooling Device For Continuous Casting Machine

4,347,897 Sumitomo, H.; and Uehara, H.
1982, Sep. 7, Hisaka Works, Ltd.
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