United States Patent [19]

Luthi

[11] **3,781,957**

[45] **Jan. 1, 1974**

[54] **DRUM INCLUDING ANNULAR GRID STRUCTURE**

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[22] Filed: **Sept. 15, 1972**

[21] Appl. No.: **289,663**

[52] **U.S. Cl.** ..... **29/121 R**

[51] **Int. Cl.** **B21b 27/02**

[58] **Field of Search** ..... 29/121 R, 121 A, 29/121 H; 162/368, 372, 374

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Primary Examiner—Alfred R. Guest

Attorney—David W. Tibbott et al.

[57] **ABSTRACT**

A drum comprising an annular grid structure which includes end portions formed only from coils of waved strip material and an intermediate portion formed from alternate coils of waved and planar strip material. The head plates at the ends of the drum have stiffening spokes or ribs connected thereto in a manner accommodating differential expansion and contraction of the head plates and spokes generally radially of the grid structure.

22 Claims, 7 Drawing Figures

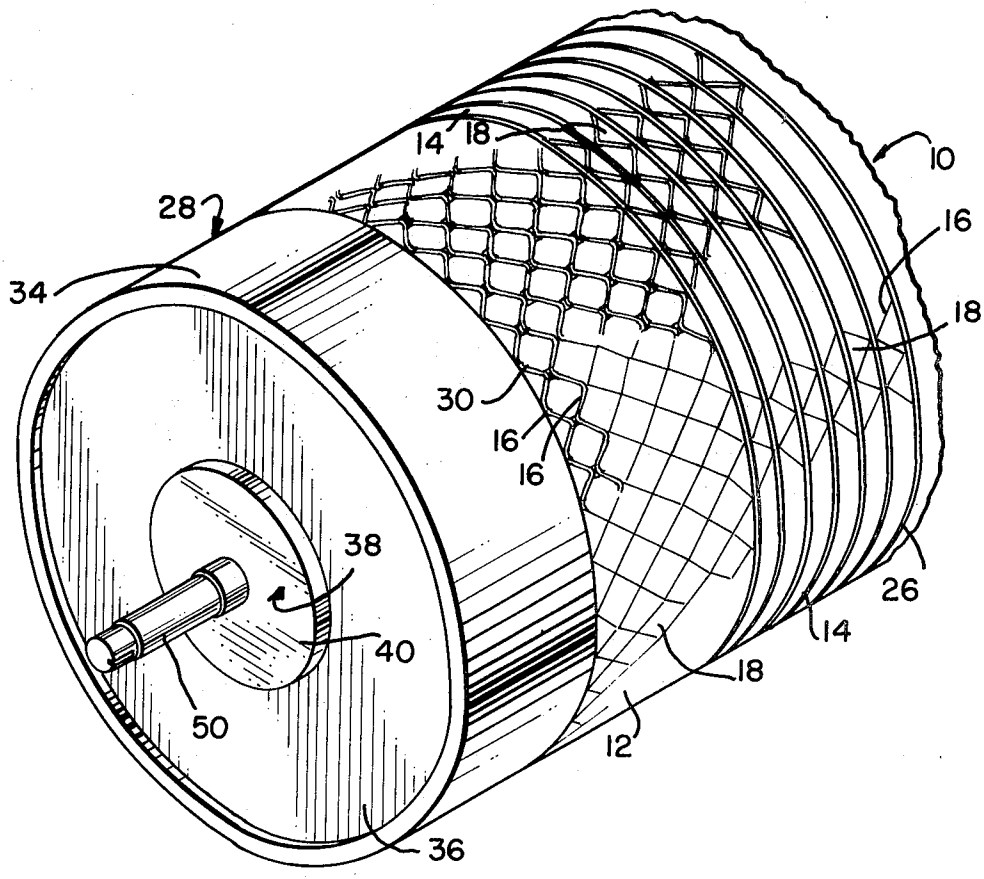


FIG. 2

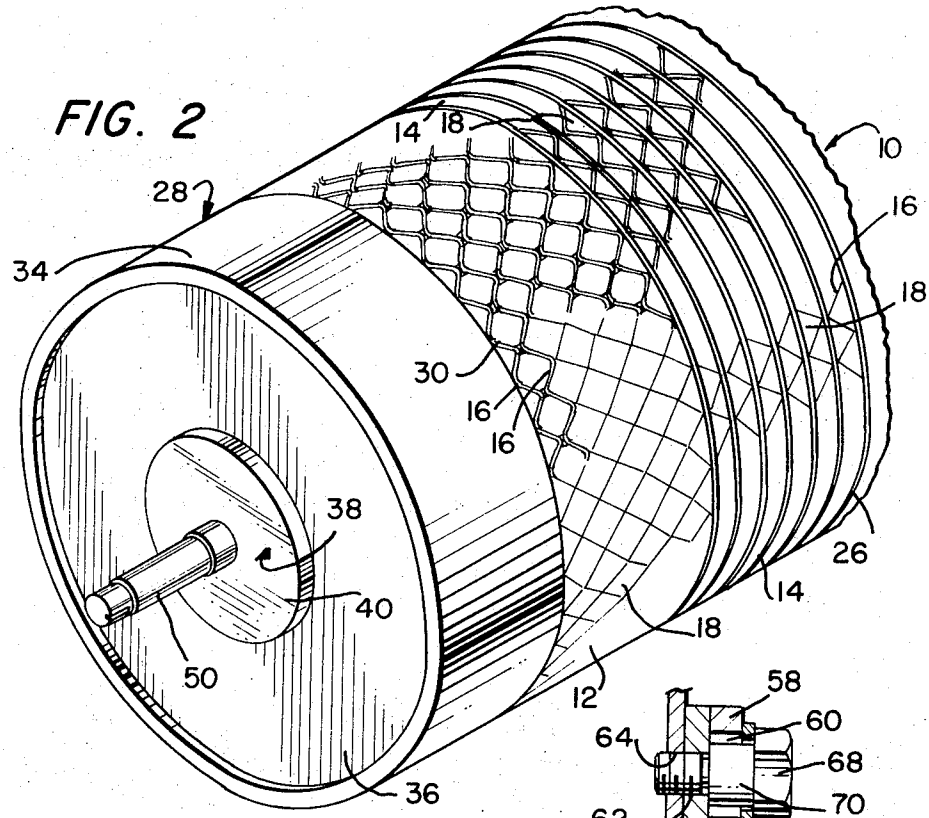
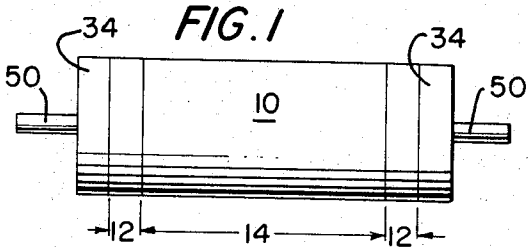


FIG. 1



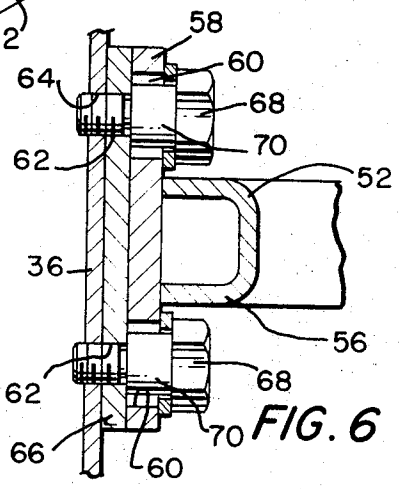


FIG. 6

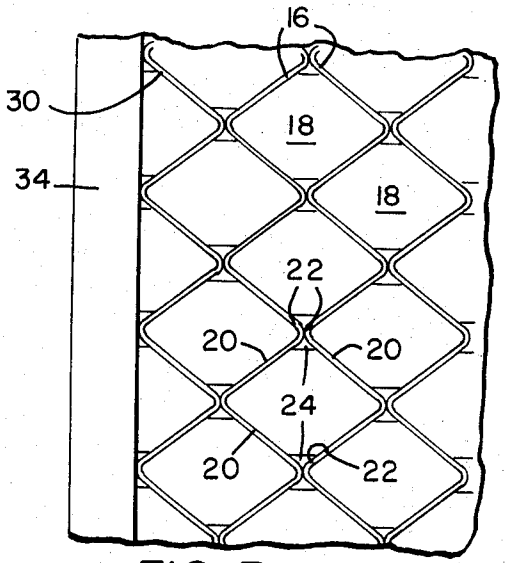


FIG. 3

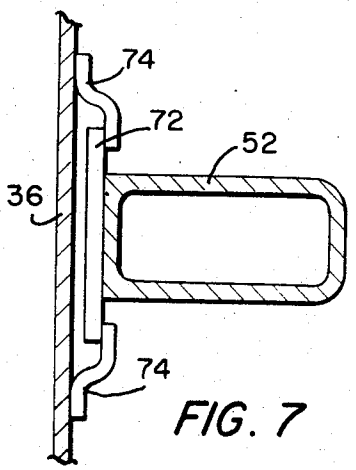


FIG. 7

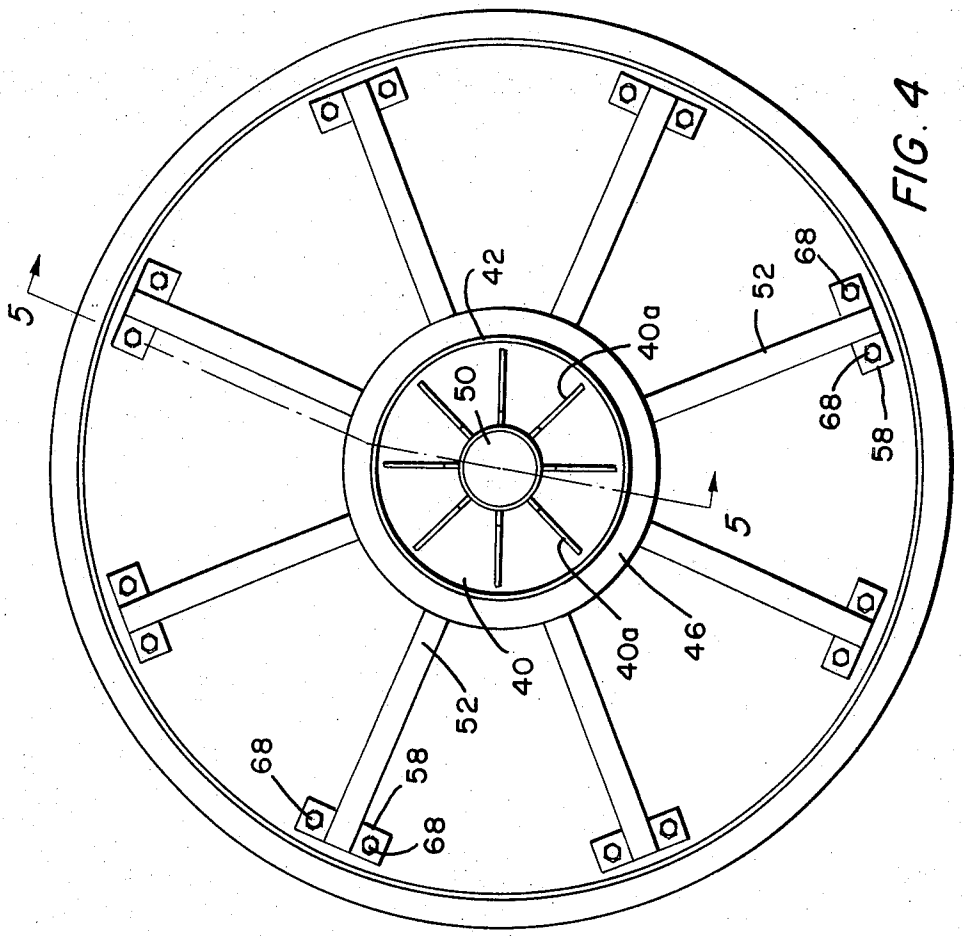
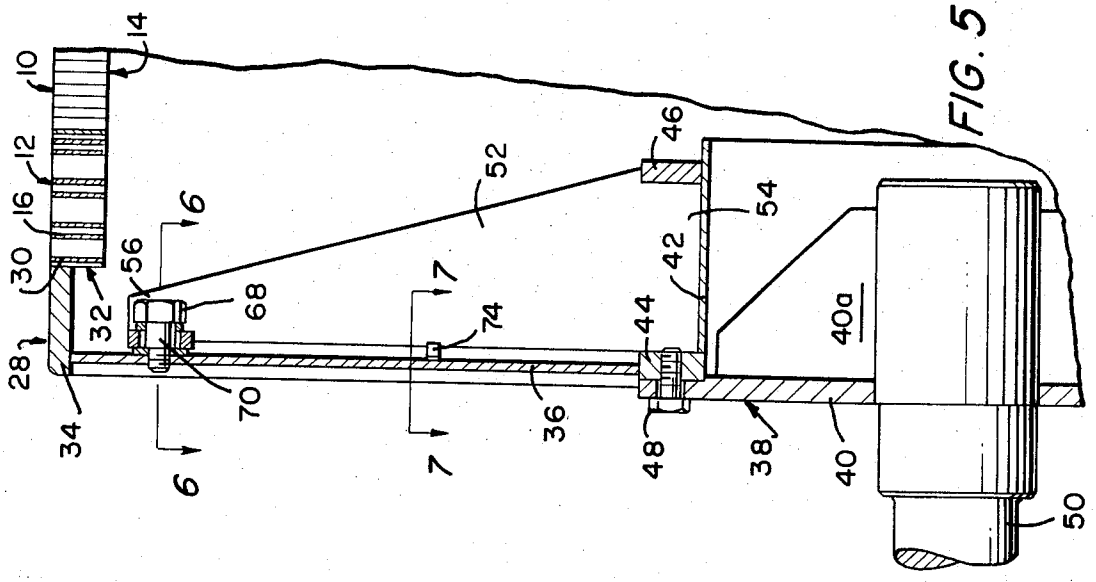

5
42
40a
52
68
50
68
58
5
40
40a
46
52
68
58
68

FIG. 4


14
10
12
16
30
32
28
34
56
68
70
6
6
52
46
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42
17
74
44
40a
36
48
38
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50

FIG. 5

DRUM INCLUDING ANNULAR GRID STRUCTURE

The present invention relates to annular honeycomb or grid structures such as, by way of specific example, the annular honeycomb drums employed by the pulp and paper making industry.

Drums of this general type are normally well suited for employment in the drying of paper webs due to their large percentage of circumferential open area and structural rigidity. In drying apparatus including such a drum, the paper web may be driven circumferentially around the grid structure beneath an overlying backing felt while air supplied at highly elevated temperature (for example, 700° to 900° Fahrenheit) is blown outwardly from the drum interior through the grid structure and the thereupon paper web and backing felt.

In apparatus of this construction, one or more cooling showers are provided for automatically directing cooling liquid (for example, liquid at around 60° Fahrenheit) onto the grid structure in the event of breakage of the paper web, thereby preventing the scorching of the backing felt which would otherwise occur upon the engagement of the felt with the grid structure after such breakage. Hence, in such apparatus upon breakage of the paper web, the grid structure is suddenly cooled from around 700° Fahrenheit by the cooling liquid, it being understood that a rapid cooling of the grid structure from 700° Fahrenheit to 60° Fahrenheit would cause a ½ inch reduction in an 84 inch diameter grid structure. Notwithstanding this cooling of the grid structure, however, the drum head plates remain at full operating temperature for a period of time, thereby causing distortion of the grid structure and resulting in such severe bending and yielding adjacent the juncture or the head plates and grid structure as will eventually result in premature drum failure. Moreover, after the cooling of the grid structure, although the drum head plates remain hot, the stiffening spokes extending along the head plates cool to provide a further source of distortion and premature failure.

In drying apparatus including a drum of the beforedescribed type, the paper web alternatively may be driven around the grid structure beneath an overlying driven wire while air supplied at the beforementioned highly elevated temperature is blown inwardly through the wire, web and grid structure and thence discharged into the interior of the drum at a greatly reduced temperature (for example, around 200° Fahrenheit). In this arrangement, upon breakage of the paper web, the grid structure will be suddenly exposed to air at a temperature much higher than 200° Fahrenheit, thereby causing problems similar to those arising upon the beforedescribed rapid cooling of the grid structure.

An object of the present invention is to provide a new and improved drum including annular grid structure, which drum is particularly constructed and arranged to withstand temperature fluctuations of even several hundred degrees without undue distortion, yielding or failure.

Another object of the invention is to provide a new and improved drum including annular grid structure, which drum is particularly constructed and arranged to accommodate differential expansion and contraction of its component parts.

Another object is to provide a new and improved drum including annular grid structure, which drum is particularly constructed and arranged to permit relative expansion and contraction of the head plates and therewith associated stiffening spokes or ribs.

Another object is to provide a drum including a new and improved annular grid structure.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein, as will be understood, the preferred embodiment of the invention has been given by way of illustration only.

In accordance with the ivnention a drum may comprise an annular grid structure including juxtaposed, laterally interconnected strip means, such strip means for at least one portion of the grid structure comprising only waved strip means and such strip means for another portion of the grid structure comprising both waved and planar strip means, also, in accordance with the invention, a drum may comprise head plate means adjacent at least one end of the grid structure, stiffening means extending along such head plate means, and means interconnecting the head plate means and stiffening means permitting relative movement thereof to accommodate differential expansion and contraction of the head plate means and stiffening means.

Referring to the drawings:

FIG. 1 is a view schematically illustrating a drum constructed in accordance with one embodiment of the invention;

FIG. 2 is an enlarged, fragmentary perspective view of the drum shown in FIG. 1;

FIG. 3 is a further enlarged, fragmentary, elevational view showing one of the end portions of the grid structure of the drum;

FIG. 4 is an enlarged elevational view showing one of the drum head plates and the therewith associated stiffening spokes;

FIG. 5 is an enlarged, fragmentary, sectional view taken on line 5—5 of FIG. 4, looking in the direction of the arrows;

FIG. 6 is an enlarged, fragmentary, sectional view taken on line 6—6 of FIG. 5, looking in the direction of the arrows; and

FIG. 7 is an enlarged, fragmentary, sectional view taken on line 7—7 of FIG. 5, looking in the direction of the arrows.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout the several views, the illustrated drum comprises an annular, cylindrical, honeycomb or grid structure **10** which includes circumferential end portions, each designated generally as **12**, and a circumferential intermediate portion **14** between and unitary with the end portions **12**. The relative lengths of the end portions **12** and intermediate portion **14** axially of the grid structure **10** are, of course, variable in different embodiments of the grid structure **10**. However, it will be understood that the length of each end portion **12** is preferably only a relatively small portion of the overall length of the grid structure **10**. For example, in a grid structure **10** approximately nine feet in length each end portion **12** might be of around six inch length with the intermediate portion **14** forming the remaining approximately eight foot length of the grid structure **10**.

The end portions **12** are of identical construction and each comprise only sheet metal, waved or non-planar strip material **16** helically wound to longitudinally extend circumferentially of the grid structure **10** with juxtaposed coils of the waved strip material **16** directly lat-

erally interconnected. The waved strip material **16** is arranged with its greatest transverse or widthwise dimension at least generally radially of the grid structure **10**; and the juxtaposed interconnected coils of the wave strip material **16** cooperate to therebetween define openings **18** at least generally radially through the thickness of the grid structure **10.** The waved strip material **16,** per se, may be of any suitable waved or nonplanar configuration and advantageously, as illustrated, is of the construction described in United States Patent Application Ser. No. 289333, entitled GRID STRUCTURE AND STRIP MEANS THEREFOR which was filed by John P. Rich on the same date as the present application and is assigned to the assignee of the present invention. More particularly, as illustrated, the waved strip material **16** includes alternating generally diagonal segments **20** and connecting segments **22,** the diagonal segments **20** extending across the central plane of the waved strip material **16** and adjacent ones of the connecting segments **22** being on opposite sides of such central plane. The connecting segments **22** are formed of arcuate, generally sharp or pointed configuration and each cooperate with the diagonal segments **20** on opposite sides thereof to define a generally V-shaped portion of the waved strip material **16.** The connecting segments **22** hence bound the at least generally pointed apexes of such generally V-shaped portions and are each provided with one or more enlarged sections **24** at which juxtaposed coils of the waved strip material **16** are interconnected, such as by welding.

The intermediate portion **14** of the grid structure **10** includes both the beforedescribed waved strip material **16** and also sheet metal planar strip material **26.** The waved and planar strip materials **16,26** are helically wound to longitudinally extend conferentially of the grid structure **10** in alternate arrangement throughout the length of the intermediate portion **14** and rigidly interconnected (for example, by welding) at the enlarged portions **24** of the connecting segments **22** of the waved strip material **16.** The alternately arranged strip materials **16,26** are disposed with their greatest transverse or widthwise dimensions at least generally radially of the grid structure **10** and cooperate to therebetween define additional openings **18** at least generally radially through the thickness of the grid structure **10.** Hence, the intermediate portion **14** throughout its length includes alternate coils of the strip materials **16,26,** juxtaposed ones of which coils are rigidly laterally interconnected at intervals; and, as will be understood, the end coils of the intermediate portion **14** are each similarly rigidly connected at intervals to the juxtaposed end coil of the thereadjacent end portion **12.**

As illustrated, the ends of the grid structure **10** are each supported by a supporting means, designated generally as **28,** which includes a generally radially extending wall **32** to which the end coil **30** of the respective, adjacent end portion **12** is affixed, preferably by welding, at the enlarged portions **24.** Each supporting means **28,** moreover, includes a supporting ring or annular plate **34,** unitary with wall **32,** which has an outer diameter generally the same as that of the grid structure **10.**

Each end of the drum includes an annular head plate **36** which may, as illustrated, close the corresponding end of the grid structure **10.** Each head plate **36** is along its outer circumference affixed to the supporting ring **34** of the thereadjacent supporting means **28,** and along its inner circumference rigidly connected to a hub or hub structure, designated generally as **38,** which comprises a plurality of annular hub elements **40, 42, 44,** and **46.** Each annular hub element **44** is welded or otherwise directly affixed to the inner circumference of the corresponding head plate **36** and rigidly carries an annular hub element **42,** projecting internally of the drum coaxial with the grid structure **10** which rigidly carries a hub element **46.** Each hub element **44,** moreover, is affixed to a hub element **40,** such as by a plurality of bolts **48,** the hub element **40,** in turn, being provided with generally radial ribs **40a** and carrying a stub shaft **50** adapted to rotatably mount the corresponding end of the drum.

A plurality of stiffening spokes or ribs **52** are arranged to extend along each of the head plates **36** internally of the drum for providing the necessary stiffness to the head plates **36.** More particularly, as shown in FIGS. **4** and **5,** the spokes **52** are each arranged to longitudinally extend generally radially of the grid structure **10** and drum head plate **36** and have inner ends **54** generally centrally thereof affixed, such as by welding, to the hub elements **42, 44, 46** whereby the inner end **54** of each spoke **52** is rigidly interconnected through a hub structure **38** to the inner end of the corresponding head plate **36.** The outer ends **56** of the spokes **52** are generally adjacent the inner circumference of the grid structure **10,** but sufficiently inwardly spaced from the thereadjacent supporting means **28** to permit longitudinal expansion of the spokes **52** generally radially of the grid structure **10.** The outer ends **56** of the spokes **52,** moreover, each carry a connecting bracket **58** which on opposite sides of the spoke **52** includes openings **60** aligned with corresponding openings **62,64** through a boss **66** affixed to the head plate **36** and the head plate **36,** respectively. The openings **60,** as shown in FIGS. **5** and **6,** are each constructed of substantially larger diameter than the aligned openings **62,64;** and mounting bolts **68** are inserted through the aligned sets of the openings **60, 62, 64** to connect the outer ends of the spokes **52** to the head plates **36.** The portions **70** of the bolts **68** received in the openings **60** are of substantially smaller diameter than the openings **60,** thereby permitting limited relative movement of the head plates **36** and the spokes **52** generally radially of the grid structure **10** to accommodate differential expansion and contraction of the head plates **36** and spokes **52** generally radially of the grid structure **10.**

Spaced intermediate its inner and outer ends **54,56,** each spoke **52** rigidly carries a connecting plate **72,** such connecting plate **72** and cooperative connecting elements **74** serving to insure that the spoke **52** properly extends along the head plate **36** while permitting differential expansion and contraction of the head plate **36** and spoke **52** generally radially of the grid structure **10.** Intermediate the connections of the spokes **52** to the head plates **36** by the connecting plates **72** and connecting elements **74** and the ends **54,56** of the spokes **52,** the spokes **52,** are, however, not fixedly connected to the head plates **36.** Also, to facilitate relative movement of the spokes **52** and head plates **36** generally radially of the grid structure **10** upon their differential expansion and contraction, a suitable lubricant is interposed intermediate each connected boss **66** and connecting bracket **58.**

From the preceeding description, it will be seen that the invention provides new and improved means for ac-

complishing all of the beforestated objects and advantages. For example, it will be seen that the described arrangement and interconnection of the spokes **52** and head plates **36** enables differential expansion and contraction thereof generally radially of the grid structure **10**, thereby avoiding the distortion, bending and yielding problems which would be inherent were the spokes **52** merely rigidly connected to the head plates **36**. Also, it will be seen that the end portions **12** of the grid structure **10**, comprising only waved strip material **16**, are extremely strong in transmitting shear load circumferentially of the grid structure **10**; and, as the ends of the grid structure **10** are held round by the supporting means **28** and head plates **36**, ovate or egg-shaped deflection of the ends of the grid structure **10** is prevented; the bending moment on the grid structure **10** is, of course, inherently rather small at its ends.

It will be understood, however, that, although only a single embodiment of the invention has been illustrated and hereinbefore specifically described, the invention is not limited merely to this single embodiment, but rather contemplates other embodiments and variations within the scope of the following claims.

Having thus described my invention, I claim:

1. A drum comprising an annular grid structure including juxtaposed, laterally interconnected strip means, said strip means for at least one portion of said grid structure comprising only waved strip means, and said strip means for another portion of said grid structure comprising both waved and planar strip means.

2. A drum according to claim **1**, wherein said grid structure includes a plurality of said portions comprising only waved strip means, said plurality of such portions being separated by a therebetween said portion comprising both waved and planar strip means.

3. A drum according to claim **1**, wherein said strip means longitudinally extend circumferentially of said grid structure and said one portion of said grid structure is an end portion thereof.

4. A drum according to claim **3**, wherein both end portions of said grid structure comprise only said waved strip means.

5. A drum according to claim **1**, further comprising head plate means adjacent at least one of the ends of said grid structure, stiffening means extending along said head plate means for stiffening said head plate means, and means interconnecting said head plate means and said stiffening means permitting relative movement thereof to accommodate differenting expansion and contraction of said head plate means and said stiffening means.

6. A drum according to claim **5**, wherein said stiffening means comprises spoke means extending generally radially of said grid structure.

7. A drum according to claim **5**, wherein said interconnecting means comprises an opening associated with one of said head plate means and stiffening means, and a retainer having a portion in said opening, said retainer portion being of substantially smaller cross-section than said opening.

8. A drum according to claim **1**, wherein said waved and planar strip means longitudinally extend circumferentially of said grid structure, said grid structure includes end portions at opposite ends thereof comprising only laterally interconnected coils of said waved strip means, and said grid structure includes an intermediate portion between said end portions comprising laterally interconnected, alternate coils of said planar and waved strip means.

9. A drum according to claim **8**, further comprising head plate means adjacent at least one of the ends of said grid structure, a plurality of spokes extending generally radially of said grid structure along said head plate means for stiffening said head plate means, and means interconnecting said head plate means and said spokes permitting relative movement thereof generally radially of said grid structure to accommodate differential expansion and contraction of said head plate means and said spokes generally radially of said grid structure.

10. A drum according to claim **9**, wherein said means interconnecting said head plate means and said spokes comprises an opening associated with one thereof and a retainer having a portion in said opening, said retainer portion being of substantially smaller cross-section than said opening.

11. A drum according to claim **9**, wherein said spokes have inner ends generally centrally of said grid structure and outer ends adjacent the inner circumference of said grid structure, said outer ends of said spokes are spaced from thereadjacent structure to permit expansion of said spokes generally radially of said grid structure, and said interconnecting means connects said spokes adjacent their outer ends to said head plate means.

12. A drum according to claim **11**, further comprising means rigidly interconnecting said inner ends of said spokes with said head plate means, and connecting means connecting said spokes with said head plate means at locations spaced longitudinally of said spokes intermediate their ends, such connecting means permitting relative movement of said spokes and said head means generally radially of said grid structure.

13. A drum according to claim **11**, comprising said head means, spokes and interconnecting means at both of its ends.

14. A drum comprising an annular grid structure including interconnected strip means, head plate means extending transversely of said grid structure adjacent one end thereof, a plurality of spokes extending generally radially of said grid structure along said head plate means for stiffening said head plate means, and means interconnecting said spokes and said head plate means permitting relative movement thereof generally radially of said grid structure for accommodating differential expansion and contraction of said head plate means and said spokes in said generally radial direction.

15. A drum according to claim **14**, wherein said interconnecting means comprises an opening associated with one of said head plate means and said spokes, and a retainer having a portion in said opening, said retainer portion being of substantially smaller cross-section than said opening.

16. A drum according to claim **14**, wherein said spokes have inner ends generally centrally of said grid structure and outer ends adjacent the inner circumference of said grid structure, said outer ends of said spokes are spaced from thereadjacent structure to permit expansion of said spokes generally radially of said grid structure, and said interconnecting means connects said spokes adjacent their outer ends to said head plate means.

17. A drum according to claim **16**, comprising means rigidly interconnecting said inner ends of said spokes with said head plate means, and connecting means con-

necting said spokes with said head plate means at locations spaced longitudinally of said spokes intermediate their ends, and connecting means permitting relative movement of said spokes and said head plate means generally radially of said grid structure, the portions of the lengths of said spokes intermediate their said connections to said head plate means being free of fixed connection to said head plate means.

18. A drum according to claim **17,** further comprising lubricant means for facilitating said relative movement of said spokes and said head plate means.

19. A drum according to claim **14,** wherein said strip means longitudinally extends circumferentially of said drum, and further comprising second head plate means extending transversely of said grid structure adjacent the other thereof, a plurality of second spokes extending generally radially of said grid structure, along said second head plate means for stiffening said second head plate means, and second means interconnecting said second spokes and said second head plate means permitting relative movement thereof generally radially of said grid structure for accommodating differential expansion and contraction of said second head plate means and said second spokes in said generally radial direction.

20. A drum according to claim **19,** wherein said each of said spokes and said second spokes has an inner end generally centrally of said grid structure and an outer end adjacent the inner circumference of said grid structure, such outer ends of the spokes are spaced from thereadjacent structure to permit expansion of the spokes generally radially of said grid structure, and the spokes are connected adjacent their outer ends by the respective interconnecting means to their respective adjacent one of said head plate means.

21. A drum according to claim **20,** further comprising hub means rigidly interconnecting said inner ends of each of the spokes with the respective adjacent one of said head plate means, and connecting means connecting each of the spokes with such head plate means at locations spaced longitudinally of said spokes intermediate their ends, said connecting means permitting relative movement of the connected spokes and head plate means generally radially of said grid structure.

22. A drum according to claim **21,** wherein each spoke is connected adjacent its outer end to the respective adjacent one of said head plate means by an opening associated with one of said head plate means and said spokes, and a retainer having a portion in said opening, said retainer portion being substantially smaller in cross-section than said opening.

* * * * *