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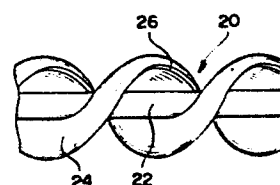
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Plastic turbulence inducing member.

A plastic turbulence inducing member comprises a shaft portion (22) and at least one spiral blade (24) extending radially from the shaft portion (22) and is inserted into a pipe for a fluid such as a refrigerant etc. in a heat exchanger etc., thereby inducing turbulence in the flow of the fluid and enhancing the heat-exchange efficiency.

FIG.2(B)



DESCRIPTION

The present invention relates to a plastic turbulence inducing member adapted to be inserted into a pipe for a fluid such as a refrigerant in a heat exchanger etc. for inducing turbulence in the flow of the fluid thereby enhancing the heat-exchange efficiency.

Turbulence inducing members made of a metal have been well known to the art. Recently, a turbulence inducing member made of a synthetic resin which is light in weight and easy to manufacture has been proposed. French Patent No. 77.30460, for example, discloses a plastic turbulence inducing member having blades twisted helically. Generally, turbulence inducing members are inserted one by one into cylindrical fluid pipes having an inside diameter equal to the maximum diameter of the turbulence inducing members and, for this reason, the plastic turbulence inducing member as disclosed in the aforementioned French Patent is formed to have its maximum diameter of about 10 mm and is provided with spiral blades less than 1 mm in thickness. Therefore, the spiral blades have sharp leading edges. Even though the spiral blades have slightly rounded portions at the leading edges thereof, these come into acute contact with the inner wall of the fluid pipe when inserted into the fluid pipe. The leading edges of the spiral blades are formed like a knife edge from a macroscopic point of view. On the other hand, the fluid pipe is generally made of a soft metal exhibiting high heat conductivity such as copper, aluminum, etc. When the turbulence inducing member

is allowed to rotate and/or vibrate due to the flowing of a fluid through the inside of the fluid pipe, therefore, the sharp leading edges of the spiral blades of the turbulence inducing member are brought into pressure contact with the inner wall of the fluid pipe, then may possibly cause the inner wall of the fluid pipe to be scraped off and, what is worse, the fluid pipe to be broken. When a turbulence inducing member is made of a synthetic resin having relatively low rigidity, it brings about a similar phenomenon though there is a difference in degree.

The object of the present invention is to provide a plastic turbulence inducing member capable of effectively preventing the inner wall of a fluid pipe to be brought into contact with the leading end portions of spiral blades from being worn off.

According to the present invention, there is provided a plastic turbulence inducing member provided with at least one spiral blade which has the leading end portion thereof formed in the shape of an arc and, more specifically, formed such that the leading edge of the leading end portion is positioned within a circle of a diameter identical with the maximum diameter of the turbulence inducing member.

Following is a description by way of example only and with reference to the accompanying drawings of plastic turbulence inducing members.

In the drawings:-

Figures 1(A) and 1(B) are a cross-sectional view and a front view respectively, showing a conventional plastic turbulence inducing member,

Figures 2(A) and 2(B) are a cross-sectional view and a front view respectively, showing one embodiment of a plastic turbulence inducing member according to the present invention,

Figure 3 is a cross-sectional view illustrating another embodiment of a plastic turbulence inducing member

according to the present invention,

Figure 4 is a cross-sectional view showing still another embodiment of a plastic turbulence inducing member according to the present invention,

5 Figures 5(A) and 5(B) are explanatory views showing the states of contact between the conventional turbulence inducing members and the inner wall of a fluid pipe, respectively, and

10 Figure 6 is an explanatory view illustrating the state of contact between the plastic turbulence inducing member of Figure 2 and the inner wall of a fluid pipe.

15 Figure 1 illustrates a conventional turbulence inducing member 10, which is provided with a pair of spiral blades 12 of a straight cross section having equal radial lengths. This turbulence inducing member 10 has disadvantages that repeated rotation and/or vibration of the turbulence inducing member 10 caused by flowing of a fluid, when inserted into a fluid pipe having an inside diameter equal to the maximum diameter of the turbulence inducing member 10, cause the leading edges of the spiral blades 12 to come into pressure contact with the inner wall of the fluid pipe, then scrape off the inner wall of the fluid pipe thereby making the thickness of the fluid pipe thinner and thinner, and consequently break the fluid pipe.

20 The present invention has been accomplished in order to eliminate the disadvantages suffered by the conventional turbulence inducing member and will now be described in detail with reference to the illustrated embodiments.

25 Figure 2 illustrates one embodiment of a plastic turbulence inducing member according to the present invention. This turbulence inducing member 20 comprises a shaft portion 22 and a pair of spiral blades 24 radially extending from the shaft portion 22 with the thickness thereof held substantially constant. The shaft portion 22 and the
30 blades 24 are integrally molded of a synthetic resin. The
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leading end portion of each of the blades 24 is bent in an arc form so that the position of the leading edge 26 thereof may fall within a circle P drawn with the maximum diameter of the turbulence inducing member 20 as its diameter, i.e. a circle having a radius of the distance between the center of the shaft portion 22 and the outermost side of the spiral blade 24. Although no specific limitation is placed on the size of the turbulence inducing member 20, there is advantageously used a turbulence inducing member 20 when the diameter of the circle P is set at 7 mm, the diameter of the shaft portion 22 at 1.5 mm, the thickness of the spiral blades 24 at 0.6 mm and the length d of the arc-shaped leading end portion of the spiral blade 24 at 3 mm, for example.

One example of methods for the manufacture of this turbulence inducing member 20 will be described briefly. A mouthpiece having an outlet of a shape identical with the cross section of the turbulence inducing member as illustrated in Figure 2(A) is rotatably attached to an extruding machine. A softened resin is extruded from the outlet by the extruding machine with the mouthpiece rotated. The extruded resin is spirally twisted by the rotation of the mouthpiece, passed through water in a cooling vessel to be cooled and hardened, and drawn from the cooling vessel. The hardened resin is cut into members to have a suitable length. The softened resin may be drawn by rotating the resin itself while fixing the mouthpiece onto the extruding machine.

Figure 3 illustrates another embodiment of a plastic turbulence inducing member according to the present invention. The turbulence inducing member 20 in this embodiment comprises a shaft portion 22 and a spiral blade 24 radially extending straight from the shaft portion and further extending so that the leading end portion is bent in an arc form and the position of the leading edge 26 falls within

the circle P as in the preceding embodiment.

As will be understood from the two embodiments described above, the number of the spiral blades 24 is not particularly limited. That is to say, three or more spiral
5 blades 24 may be formed integrally with the shaft portion 22. The leading end portion of the spiral blade 24 may be bent in either direction irrespective of the direction in which the spiral blade 24 is twisted relative to the shaft portion 22 of the turbulence inducing member 20.

10 Figure 4 illustrates a still another embodiment of a turbulence inducing member according to the present invention. In this embodiment, a swollen portion 30 is formed integrally with the straight leading end portion 28 of a spiral blade 24. The swollen portion 30 has an arc-shaped
15 outer circumference of a diameter not less than two times of the thickness of the straight leading end portion 28 of the spiral blade 24.

It will now be described with reference to Figures 5(A), 5(B) and 6 that the turbulence inducing member 20 of
20 the present invention having the leading end portions of the spiral blades 24 constructed as in the aforementioned embodiments are more excellent than the conventional turbulence inducing member 10.

The sharp leading edge of the spiral blade 12 of the
25 conventional turbulence inducing member 10 comes into sharp contact with the inner wall 32 of the fluid pipe as illustrated in Figure 5(A). When the turbulence inducing member 10 is allowed to rotate and/or vibrate by the flowing of a fluid, therefore, the sharp leading edge of the
30 spiral blade 12 is brought into pressure contact with the inner wall 32 of the fluid pipe and consequently scrapes off the inner wall 32 at the specific portions thereof. To be specific, since the turbulence inducing member 10, though having the blades twisted spirally, has the spiral
35 blades 12 extending straight from the shaft portion over

the entire length thereof, the spiral blades 12 themselves do not exhibit elasticity in the direction of the shaft portion. Further, the sharp leading edges of the straight extending spiral blades 12 come into linear contact with the inner wall 32. For these reasons, the rotation and/or vibration of the turbulence inducing member 10 accompanied by the flowing of the fluid inevitably causes the sharp leading edge to scrape the inner wall 32 off. Even when a round is positively given to the leading edge of the spiral blade 12 of the conventional turbulence inducing member, as illustrated in Figure 5(B), the corner formed between the rounded surface and the side wall of the spiral blade 12 has an angle of approximately ninety degrees and the thickness of the spiral blade 12 is very small. In this case, therefore, the corner is brought into sharp contact with the inner wall 32 of the fluid pipe and the inner wall 32 is scraped off similarly to the case in Figure 5(A).

On the other hand, in the present invention, since the turbulence inducing member 20 has the leading end portion of the spiral blade 24 formed in the shape of an arc, the leading end portion of the spiral blade 24 comes into curved-surface contact with the inner wall 32 of the fluid pipe, as illustrated in Figure 6. This curved-surface contact can prevent the inner wall 32 of the fluid pipe from being worn off to the maximum extent. Further, since the leading edge 26 of the arc-shaped leading end portion of the spiral blade 24 is positioned within the circle P of a diameter identical with the maximum diameter of the turbulence inducing member 20, it does not come into direct contact with the inner wall of the fluid pipe. In other words, the arc-shaped circumferential surface of the leading end portion having large curvature comes into contact with the inner wall 32 of the fluid pipe. Therefore, the contact between the leading end portion of the spiral blade 24 and the inner wall 32 of the fluid pipe is elastically

maintained at all times. Even though the turbulence inducing member 20 is allowed to rotate and/or vibrate by the flow of the fluid, the leading edge 26 of the spiral blade 24 is elastically bent in the direction of the arrow A in Figure 6, i.e. in the direction of the shaft portion 22 of the turbulence inducing member 20, and therefore desired curved-surface contact is maintained at all times. According to the present invention, therefore, there is no fear of the leading edge of the spiral blade scraping off the inner wall 32 of the fluid pipe as has been done by the conventional turbulence inducing member.

As is clear from the above, according to the plastic turbulence inducing member of the present invention, since the leading end portion of the spiral blade is formed in the shape of an arc and comes into curved-surface contact with the inner wall of the fluid pipe, it is possible to effectively prevent the inner wall of the fluid pipe from being worn off and scraped off. Further, since the formation of the leading end portion of the spiral blade to be bent or to be provided with the swollen portion having the arc-shaped outer circumference can afford more vigorous turbulence than in the past to the flow of the fluid, the heat-exchange efficiency is further enhanced.

CLAIMS

1. A plastic turbulence inducing member to be inserted into a pipe for a fluid thereby inducing turbulence in the flow of said fluid and enhancing the heat-exchange efficiency, which turbulence inducing member comprises a shaft portion (22) and at least one spiral blade (24) extending radially from said shaft portion (22), said at least one spiral blade (24) having the leading end portion (28) thereof formed in the shape of an arc so as to come into curved-surface contact with the inner wall (32) of said pipe at the arc-shaped outer circumferential portion thereof.
2. A plastic turbulence inducing member as claimed in claim 1, wherein the leading end portion (28) of said at least one spiral blade (24) formed in the shape of an arc has the leading edge falling in position within a circle (P) having a diameter identical with the maximum diameter of the plastic turbulence inducing member.
3. A plastic turbulence inducing member as claimed in claim 1, wherein the leading end portion (28) of said at least one spiral blade (24) is provided integrally with a swollen portion (30) having an arc-shaped outer circumferential surface of a diameter not less than two times of the thickness of said at least one spiral blade (24).
4. A plastic turbulence inducing member substantially as herein described with reference to Figures 2(A), 2(B), 3, 4 and 6 of the accompanying drawings.

FIG.1(A)

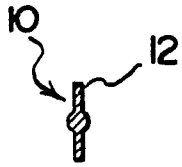


FIG.1(B)

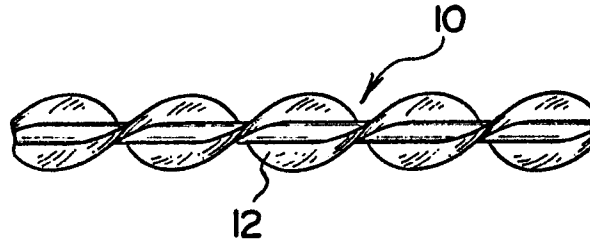


FIG.2(A)

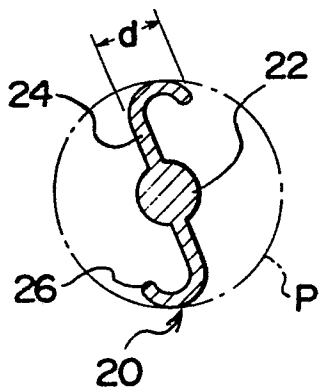


FIG.2(B)

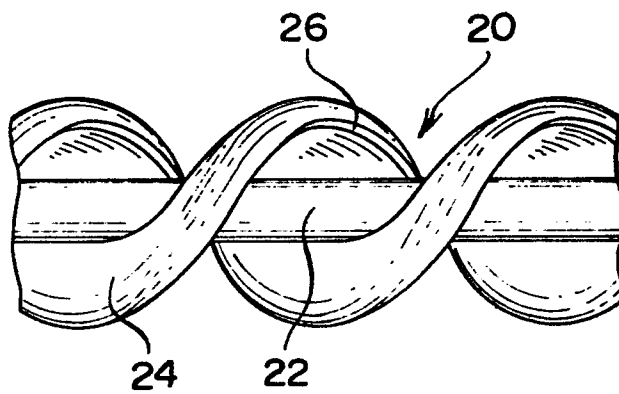


FIG.3

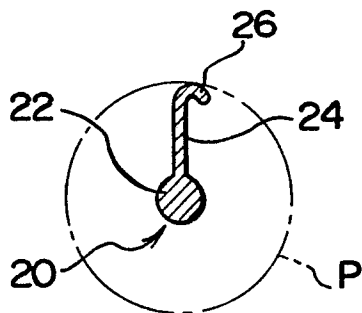


FIG.4

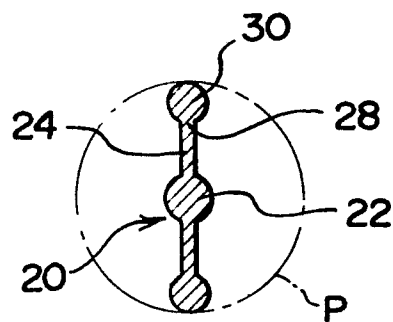


FIG. 5(A)

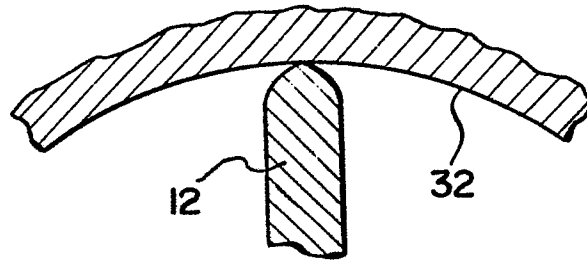


FIG. 5(B)

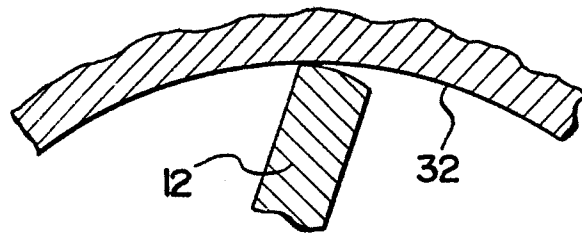
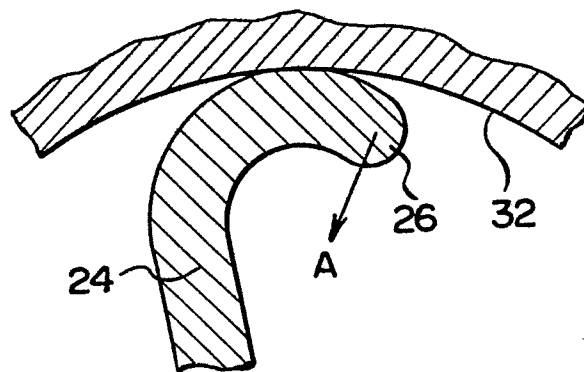


FIG. 6





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. *)
X	FR-A-2 436 959 (FERODO) *Pages 2,3; figures 2,3*	1,2,4	F 28 F 13/12
X	US-A-1 672 617 (LASKER) *Page 1, lines 46-108; figures 3,5*	1,2,4	
A	FR-A- 385 536 (TABOULEVITCH) *Figure 6*	1,3	
A	FR-A-1 082 949 (VANDEVELDE) *Figures 3,4*	1,4	
A	FR-A-2 442 421 (FERODO)		
A	FR-A-2 244 149 (FERODO)		TECHNICAL FIELDS SEARCHED (Int. Cl. *)
A	US-A-4 190 105 (DANKOWSKI)		F 28 F F 22 B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25-11-1982	Examiner SCHOUFOUR F.L.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone		T : theory or principle underlying the invention	
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