Dec. 23, 1969 H. FAIGLE 3,485,485

COOLING SCREEN

Filed Nov. 7, 1967 3 Sheets-Sheet 1

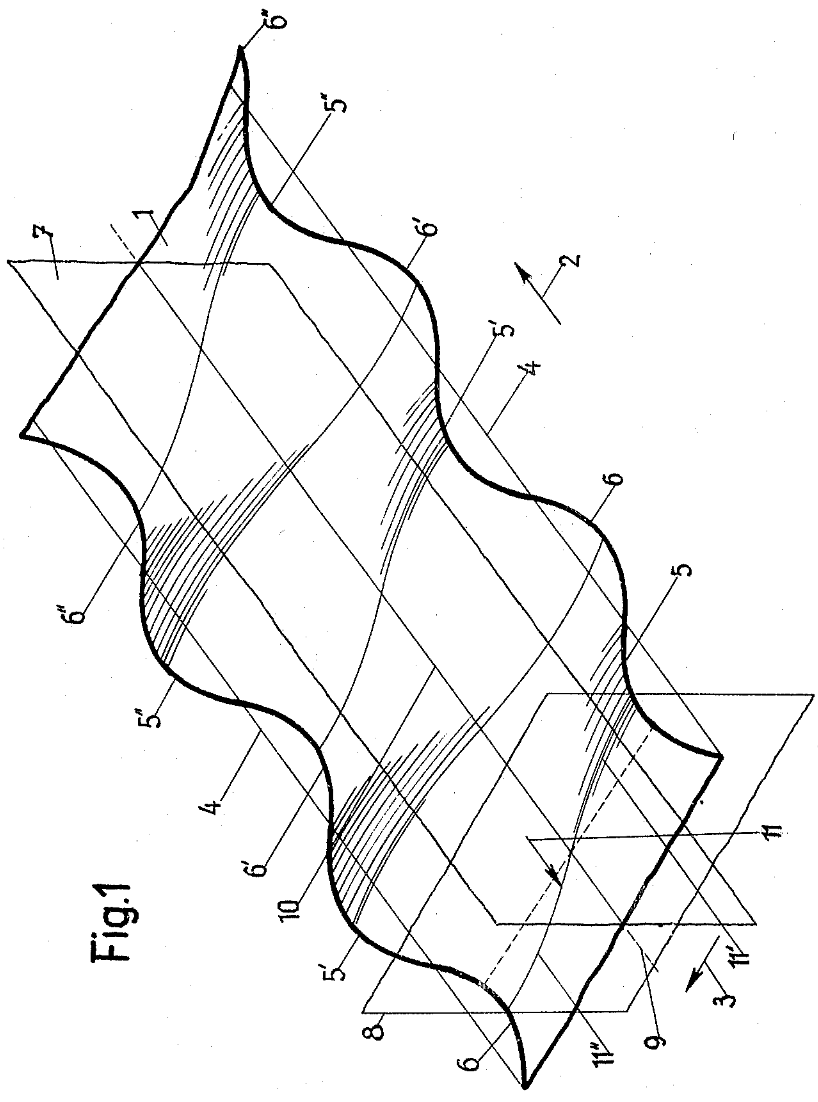


Fig.1

Dec. 23, 1969 H. FAIGLE 3,485,485

COOLING SCREEN

Filed Nov. 7, 1967 3 Sheets-Sheet 2

Fig. 2

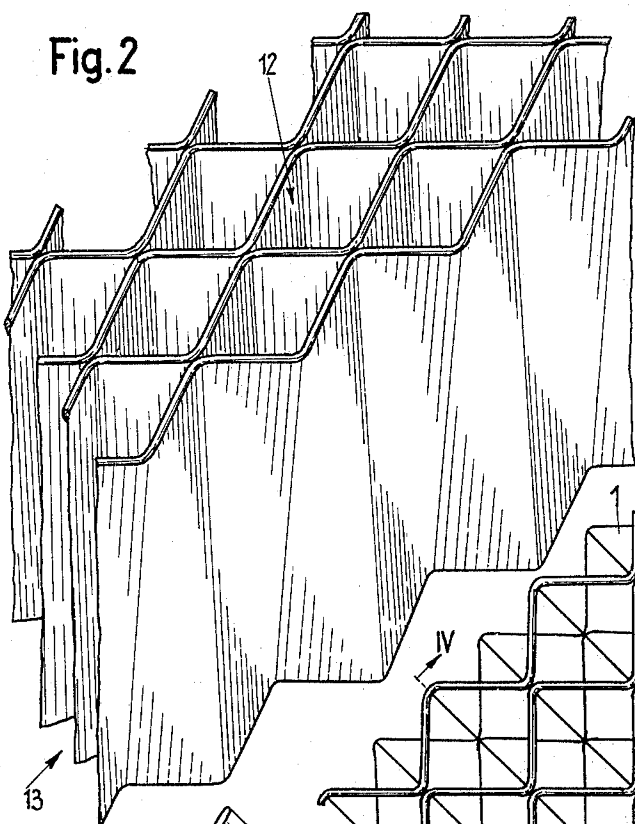


Fig. 3

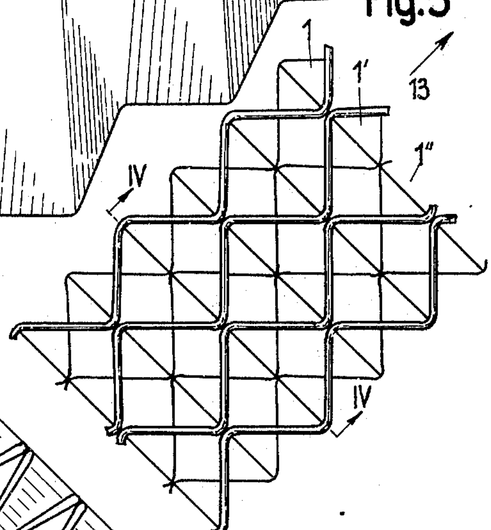
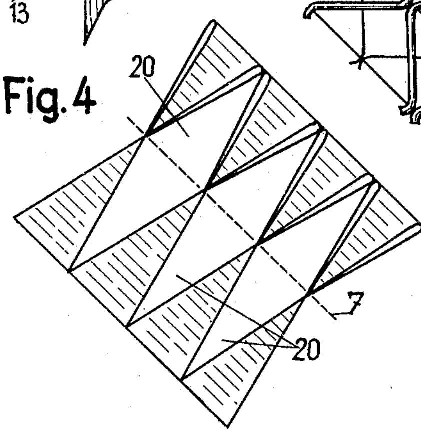


Fig. 4



Dec. 23, 1969 H. FAIGLE 3,485,485

COOLING SCREEN

Filed Nov. 7, 1967 3 Sheets-Sheet 3

Fig.5

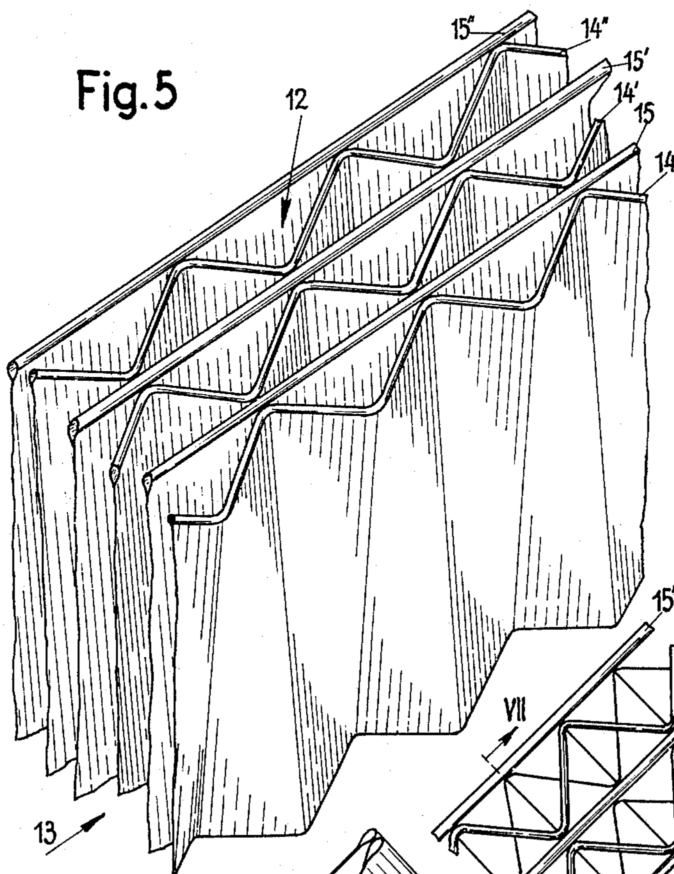


Fig.6

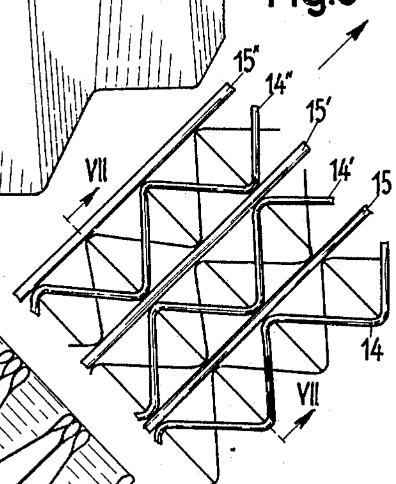
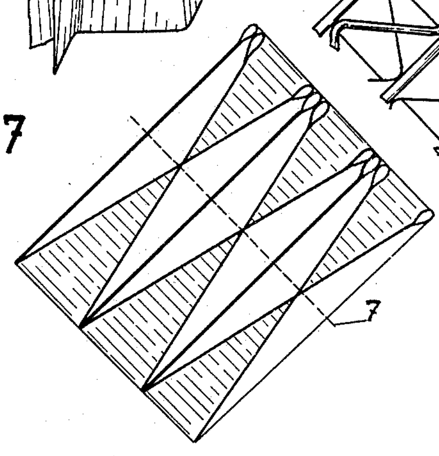


Fig.7



United States Patent Office 3,485,485 Patented Dec. 23, 1969

1

3,485,485

COOLING SCREEN

Heinz Faigle, 15 Sagenkanal, 6971 Hard, Austria

Filed Nov. 7, 1967, Ser. No. 681,242
Claims priority, application Austria, Nov. 11, 1966, A 10,470/66
Int. Cl. F28f *3/08, 3/02;* F28c *1/00*
U.S. Cl. 261—112 5 Claims

ABSTRACT OF THE DISCLOSURE

A cooling screen is constituted by a plurality of sheets in secured contacting relation, wherein each sheet has a median longitudinal axis with corrugations in the longitudinal direction on either side of the axis, said corrugations being longitudinaly offset from one another on either side of the axis so that when viewed transversely the ridge of one corrugation is aligned with the valley of the other corrugation, the ridges and valleys of the corrugations being equal. When viewed longitudinally, unimpeded passageways are formed between adjacent sheets.

The invention relates to a cooling screen, especially for cooling towers, consisting of several strips arranged side-by-side, preferably of metallic, mineral or synthetic material, each of the strips, at least partially, having a wavelike character in two different, crossing directions, said wavetrains being superposed to one another; thus, referring to a median plane of the strips, in the longitudinal as well as in the transverse extension of the strip, at least partially, a positive half wave lying in front of this plane is followed by a negative half wave lying behind said plane and a negative half wave lying behind said plane is followed by a positive half wave in front of said plane.

In former times cooling screens for cooling towers were manufactured of wood. Today synthetic, metallic or mineral materials are used for this purpose. A known construction of this type consists of tapelike strips, having a zig-zag character in longitudinal direction. Several strips are arranged side-by-side and their median planes are combined to plates in parallel to one another, the different strips being firmly connected with one another. The cooling screens thus formed are open perpendicularly to their plane in such manner that the water to be cooled can flow from the top to the bottom and the cooling air from the bottom to the top.

It is a disadvantage of this construction that these cooling screens are only open in one direction so that they can be inserted only in horizontal direction. It is also disadvantageous that the water to be cooled, condensate or the like tends to form a river along the zig-zag strips, which is very unfavorable for the cooling effect.

In another known cooling screen of this type the individual tapelike strips also have a zig-zag character, but the direction of the zig-zag character forms an acute angle with the longitudinal extension of the strip. Though cooling screens of this type are open for the air flow in two directions perpendicular to each other, it cannot be neglected that cooling screens of this type oppose a considerable resistance to the air flow in such manner that the rate of free air flow is relatively small due to the temperature drop in the cooling tower. In the case of a forced air flow by means of blowers they must be dimensioned accordingly. If a straight strip is inserted between two zig-zag strips for the purpose of mechanical stabilization, the air flow in transverse direction is completely blocked.

A cooling tower is known, the large open-surface coolers of which consist of plates which are waveshaped in the direction of flow of the cooling air and are spaced

2

from one another; the distance holders are plates which are waveshaped in the direction of flow of the cooling air and transversely thereto.

As experience has shown, the cooling capacity referred to the unit area which is given through numerous factors regarding construction and inflow technique, like for example part of the wettable surface, resistance to flow, velocity of flow, wettable surface per unit of volume, degree of turbulence of the air flowing through and the like, is not satisfactory.

It is an object of the invention to create a cooling screen which is not only inserted in vertical and horizontal direction, but can be driven with cooling air in any possible position in countercurrent or in reactive current; thus the water to be cooled, the condensate or the like is practically prevented from forming a river and the highest possible cooling effect with small resistance to flow is obtained.

According to the invention this is only obtained by the fact that the median planes of several strips are arranged in parallel to one another and that the positive or negative wave halves of one strip are connected, at least partially, with the negative or positive wave halves of the adjacent strip, for example are glued or welded together, and that the wave length of one wavetrain is a multiple of the wavelength of the other wavetrain. A cooling screen of this type is not only open perpendicularly to its plane, but also transversely thereto, so that an individual cooling screen suffices for the two types of installation as mentioned, which brings with it considerable functional advantages and a favorable effect as to storage. Moreover, the configuration of the cooling screen according to the invention not only produces an active, turbulent movement of the water to be cooled, condensate or the like, but also of the air flowing through the cooling screen, in such manner that an intensive cooling can be realized by relatively simple means on short distances, which causes small structural dimensions of the cooling device. It is essential that free openings going through and lying one behind the other are provided for the air flow in transverse as well as in longitudinal direction, which only constitute a small resistance to flow without preventing the turbulence of the air flow.

In order to illustrate the multiplicity of possible embodiments according to the invention, the latter is described with reference to the accompanying drawings without being limited to the embodiments described.

FIGURE 1 is a perpective view of a tapelike strip, FIGURE 2 is a perspective view of a cooling screen consisting of a tape-like strip; FIGURE 3 is a topview and FIGURE 4 is a view in the direction of the arrows indicated in FIGURE 3; FIGURES 5 and 6 show a variant of the cooling screen according to FIGURE 2 in perspective and plan view respectively; FIGURE 7 is a view in the direction of the arrows indicated in FIGURE 6.

The tapelike strip **1**, which is manufactured for example of a plastic material responding to mechanical and thermic stress, has a wavelike character in the longitudinal direction (arrow **2**) as well as in the transverse direction (arrow **3**), the two wavetrains being superposed in such manner that, referring to the median plane **4** of the strip in the longitudinal as well as in the transverse extension (**2, 3**) of the strip **1**, a positive half wave **5, 5′, 5″** lying in front of this plane **4** is followed by a negative half wave **6, 6′, 6″** lying behind said plane **4** and a negative half wave lying behind said plane is followed by a positive half wave lying in front of said plane. **7** and **8** are two sectional planes perpendicular to each other going and the median plane **4**. Sectional plane **7** comprises the central axis **9** of the strip **1** and is parallel thereto; the sectional plane **8** is in the zone of the vertex height of a wave half **5** or **6**; thus an approximately straight line **10** is obtained as the intersection of plane **7** and strip **1** which coincides with the longitudinal central axis **9**; on the other hand the intersection of strip **1** and plane **8** is a waveshaped line **11** (FIGURE 1). Though the wavetrains in FIGURE 1 extend continuously, it is within the scope of the invention to form the strip in such manner that the individual cutting borders are straight lines, for example trapezoidal or triangular lines. The continuous extension of the wavetrains is not obligatory for the invention, either; it is possible to provide an interrupted wavetrain or to form the strips only on part of their length in the manner as proposed. It is not necessary for the invention that the directions of the two wavetrains are absolutely perpendicular to each other; it is possible that the two directions form an acute angle with each other. The wave train in transverse direction (arrow **3**) of the strip **1** is relatively short so that the cutting border **11** forms a positive or negative wave quarter **11′** and **11″** with the plane **8**, referring to the median plane **4** of the strip. It is within the scope of the invention to provide a wider strip or to form the waves in transverse direction in such manner that several positive and negative wave halves appear in this direction. As can be seen from the drawing, it is essential that the wavelength of one wavetrain is a multiple of the wave length of the other wavetrain, the wavelength of the wavetrain (**11**) extending in transverse direction (**3**) preferably being a multiple of the wavelength of the wavetrain extending in longitudinal direction (**2**).

In order to form the cooling screen, the median planes **4** of several strips (**1, 1′, 1″**) of the type described are arranged parallel to one another and side-by-side; thus structures like honey combs (FIGURES 2, 3 and 4) are obtained extending in two directions, the individual strips being firmly connected with one another, for example by being glued or welded together, in the zone of the positive or negative wave halves touching one another.

It can clearly be seen from the FIGURES 2, 3 and 4 that the cooling screen thus formed is open in two directions (arrows **12** and **13**) and that, due to the chosen deformation, the river formation of the water to be cooled is excluded.

It can clearly be seen from the FIGURE 4, that wide openings **20** going through are provided for the air flow in direction of the arrow **13** through which the air flow passes without being turned nor finding considerable resistance. The conditions of flow are favorable (small resistance to flow on the one hand, high degree of turbulence on the other) if the height of the wave halves of the one wavetrain is smaller than the wave length of the superposed wavetrain, crossing the latter. Preferably the rate of the height of the wave halves of the one wavetrain to the wave height of the crossing wavetrain is at least 1:5, preferably 1:20.

The variant of the cooling screen according to FIGURES 5, 6 and 7 differs from the embodiment described in that plane strips **15, 15′** are inserted between the deformed strips **14, 14′, 14″**. It is obvious that the deformed strips **14, 14′, 14″** may be mirror-inverted or displaced relative to one another with reference to the plane strips **15, 15′**. If plane intermediate strips **15, 15′** are used, the cooling screens are continuously open in two directions

so that the above mentioned installation types and methods of operation are true for this type of cooling screen, too. It is important that the cooling air can flow through the screen, despites presence of the plane strips, in the direction of the arrow **13** practically without hindrance (FIGURE 7), the abovementioned rate (height of the wave half/wavelength) being true for this embodiment, too.

In order to obtain large-area joints, the wave halves are chamfered in their vertex zone in such manner that a parallel surface to the median plane **4** is formed.

Due to the proposal according to the invention, cooling screens of a random dimension may be constructed which respond to the object of the invention (vertical and horizontal installation in any position) by simple means; the cross section of the opening provided for the air passage being large and offering only small resistance to air flow; on the other hand a high degree of turbulence is obtained in such manner that the cooling screen offers a maximum of cooling capacity.

What I claim is:

1. A cooling grid for cooling towers, comprising a plurality of sheets arranged parallel to one another, each sheet having a median longitudinal axis with corrugations in the longitudinal direction on either side of said axis, said corrugations on either side of the axis being longitudinally offset from one another so that when viewed transversely the ridge of one corrugation is aligned with the valley of the other corrugation, the ridges and valleys of the corrugations being equal, and means joining said sheets to one another in contacting relation at the ridges and valleys.

2. A grid as claimed in claim **1**, wherein said longitudinal corrugations define corrugations in transverse planes perpendicular to the longitudinal axis.

3. A cooling grid according to claim **2**, wherein one corrugation in one direction of the sheet has a wavelength which is a multiple of the wavelength in the other direction.

4. A cooling grid according to claim **3**, wherein the vertex of the ridges and valleys of one of the corrugated sheets is smaller than the larger wavelength of the corrugation.

5. A cooling grid according to claim **4**, wherein the vertex of a wave ridge or depression of one of the corrugated sheets is less than one-fifth of the larger wavelength of the corrugation of the sheet.

References Cited

UNITED STATES PATENTS

3,084,918	4/1963	Kohl et al.	261—112
3,374,994	3/1968	Greer	261—112
3,415,502	12/1968	Munters	261—112

FOREIGN PATENTS

846,092	8/1952	Germany.

OTHER REFERENCES

Reichenbacher: German printed application 1,058,077, 5–1959.

TIM R. MILES, Primary Examiner