

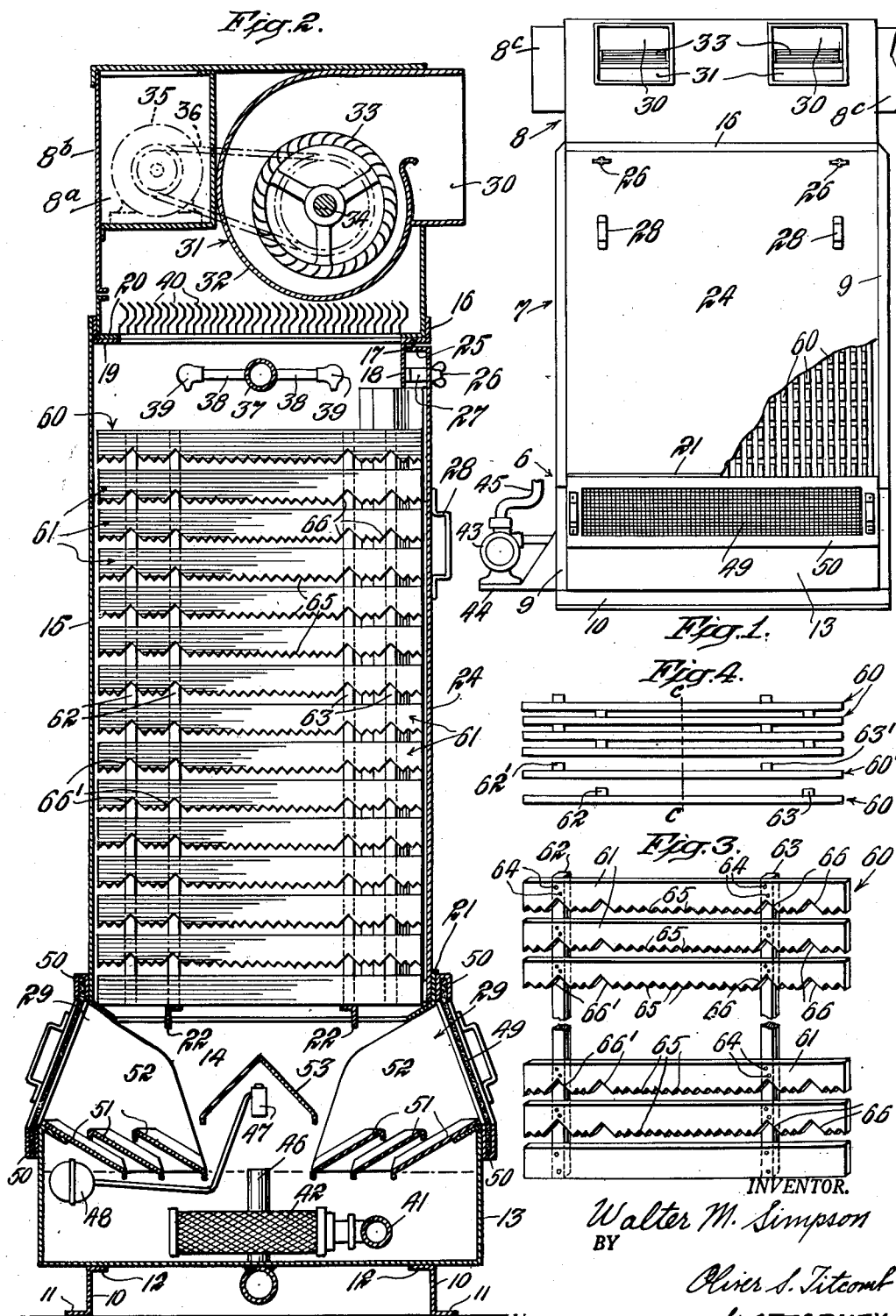
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EVAPORATIVE WATER COOLER

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EVAPORATIVE WATER COOLER

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6 Claims. (Cl. 261-112)

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The present invention relates to improvements in evaporative water coolers and more particularly to a liquid distributing packing for use in a cooling tower.

In cooling towers the water to be cooled is delivered through spray nozzles or other liquid supplying means onto the top of a liquid distributing packing providing a large surface area over which the water flows by gravity in a thin film. Air circulating through the packing countercurrent to the direction of flow of the water evaporates a portion of the water and removes the latent heat of vaporization from the remaining portion of water and thereby reduces its temperature. Different forms of liquid distributing packing have heretofore been used but in all such packings the liquid to be cooled tends to run through the packing in localized streams.

One of the objects of the present invention is to provide an improved packing for a cooling tower which produces a more uniform liquid distribution throughout the packing.

Another object is to provide a cooling tower packing comprising a plurality of individual slat-frames arranged in side by side relationship to facilitate assembly or removal of the packing for cleaning or replacement of parts.

Another object is to provide a cooling tower packing of slat-frames in which each slat is provided with drip-forming projections at its lower edge to deliver water onto the next lowermost slat uniformly throughout its length.

Another object is to provide an assembly of wooden slat-frames so arranged as to permit swelling or expansion of the individual frames without expansion of the packing.

Still another object is to provide a cooling tower for domestic use to supply cooling water to a household appliance such as an absorption refrigeration unit.

These and other objects will become more apparent from the following description and drawing in which like reference characters denote like parts throughout the several views. It is to be expressly understood, however, that the drawing is for the purpose of illustration only and not a definition of the limits of the invention, reference being had for this purpose to the appended claims. In the drawing:

Fig. 1 is a front elevational view of a cooling tower incorporating the improved packing of the present invention;

Fig. 2 is an enlarged sectional view through the cooling tower showing the arrangement of the packing therein;

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Fig. 3 is a perspective view of one of the individual slat-frames; and

Fig. 4 is a plan view of a group of slat-frames arranged in side by side relationship to provide a packing assembly and showing the slats of each frame held in spaced relationship by the vertical supporting strips.

Referring to the drawing, the present invention is shown applied to a cooling tower comprising an upright sheet-metal housing or casing having a lower part 6, constituting a sump, an intermediate part 7 for enclosing a liquid distributing packing constituting the subject matter of the present invention and an upper part 8 constituting a blower assembly. The sections 6, 7 and 8 are supported by a frame having corner stanchions 9 with plates 10 extending between the lower ends of the stanchions 9 at the front and back of the frame. The plates 10, see Fig. 2, have outwardly projecting flanges 11 at their lower edges to provide feet for supporting the frame and inwardly projecting flanges 12 at their upper edges for supporting a rectangular sump tank 13. Sump tank 13 projects beyond the front and back of the frame and overlying the ends of the tank are panels 14 attached to the corner stanchions 9 at the inside of the frame. The ends of the tank 13 and panels 14 constitute the lower part 6 of the upright housing or casing.

The intermediate part 7 of the casing comprises a back panel 15 and end panels (not shown) which are mounted on the corner stanchions 9 of the frame to provide an enclosing housing having an open front. An upper cross piece 16 extends between the end panels of the intermediate section 7 of the casing at the top of the open front which is of angle shape in cross section forming a front flange, a cross web constituting a seat 17 and a depending flange 18 offset rearwardly from the front flange, see Fig. 2. Angle flanges 19 are attached to the inside faces of the rear and end panels to provide a seat 20 on three sides constituting a continuation of the seat 17 of the cross piece 16. A lower cross piece 21 also is provided at the bottom of the open front having a front flange offset forwardly from the plane of the upper cross piece flange 16. The lower edge portions of the back panel 15, the end panels and the lower edge of the cross piece 21 are flanged inwardly to stiffen the structure. Extending between the lower edge portions of the end panels are beams 22 for supporting the liquid distributing packing as later described.

A removable service door 24 claimed in my co-pending application for Letters Patent Serial No.

737,302 filed concurrently herewith, now abandoned, cooperates with the end panels and upper and lower cross pieces 16 and 21 to close the open front of the intermediate casing part 7. The service door 24 has its lower end set into the forwardly offset flange of the lower cross piece 21, a rearwardly projecting flange 25 at its upper edge abutting the depending flange 18 of the cross piece 16 and suitable sealing means at the sides of the door to seal the intermediate casing part 7 to prevent water from leaking out or air from leaking into the casing. Removable wing bolts 26 are screwed into brackets 27 on the cross piece 16 to detachably connect the service door to the casing and handles 28 are provided on the door to facilitate its removal.

Air inlet openings 29 are provided between the lower and intermediate casing parts 6 and 7 at the front and back of the casing and the openings extend throughout the width of the casing. The air inlet opening 29 at the front of the casing extends between the top edge of the sump tank 13 and the cross piece 21 and the air inlet opening at the back of the casing extends between the top edge of the sump tank and the bottom edge of the rear panel 15.

The upper casing part 8 is a hollow boxlike sheet-metal casing having an open bottom and resting on the seats 17 and 20; the lower edges of its front and rearward walls being shaped to conform to the seats. The casing part 8 is mounted on the intermediate casing part 7 by merely placing it on the seats 17 and 20. On one side of the upper casing part 8 are outlet openings 30 through which air from the casing is discharged. Suitably mounted in the casing part 8 are induction fans 31 for drawing air into the casing through the air inlet openings 29 and discharging it through the air outlet openings 30. Each fan 31 comprises a scroll casing 32 and blade wheel 33 and the wheels of the plurality of fans are mounted on a common shaft 34 driven by a motor 35 and belt 36 positioned forwardly of the line of section of Fig. 2 and indicated by dotted lines. The motor 35 is mounted in a compartment 8a in the casing part 8 and having a small service door 8b to permit access to the motor. Detachable housings 8c at the ends of the casing part 8 enclose the bearings for the wheel shaft 34 and the belt 36.

Water to be cooled is delivered to the top of the intermediate part 7 of the casing by a pipe 37 having branches 38 with spray nozzles 39 at their ends. The water delivered from the spray nozzles 39 flows by gravity through the intermediate part 7 of the casing and into the sump tank 13. Thus, the water flows countercurrent to the direction of flow of air through the casing and a series of water separating baffle plates 40 are provided in the upper part 8 between the spray nozzles 39 and fans 31 to reduce the amount of spray discharged with the air.

Mounted in the sump tank 13 and forming an integral part thereof is a suction pipe 41 having an inlet filter screen 42. The suction pipe 41 extends through the end of the sump tank 13 and is connected to a motor driven pump 43 mounted on a platform 44 adapted to be attached to the corner stanchions 9 adjacent the sump tank at either end of the frame. An outlet pipe 45 from the pump 43 delivers cooled water from the sump tank 13 to the place where it is to be used. An overflow pipe 46 is also provided in the sump tank 13 which extends vertically a predetermined distance above its bottom. Make-up

water is supplied to the sump tank 13 by a water valve 47 suitably supported above the sump tank and controlled by a float 48 in the tank.

A combined air inlet screen and splash baffle assembly as claimed in my application for Letters Patent Serial No. 737,303 filed concurrently herewith, now Patent 2,562,827 dated July 31, 1951, is mounted in each of the air inlet openings 29. Suffice it to state herein that each combined air inlet screen and splash baffle assembly is in the nature of a drawer to adapt it to be quickly inserted or withdrawn from the casing. Each assembly comprises an air screen 49 enclosed in a marginal frame 50 and a plurality of spaced angularly arranged baffle plates 51 extending between wings 52 at opposite ends of the frame. A baffle 53 extending between the panels 14 cooperates with the innermost splash baffle plates 51 to cover the entire cross-sectional area of the casing. The arrangement of the float 48 is such as to maintain a liquid level in the sump tank 13 above the bottom of the splash baffle plates 51 to eliminate the noise of water dripping directly from the packing into a pool of water in the tank.

In accordance with the present invention an improved packing is provided in the intermediate part 7 of the casing for uniformly distributing the liquid in a thin film over a large surface area as it flows therethrough. The packing is made up of a plurality of slat-frames 60 arranged in side by side relationship and supported on the cross-beams 22 to completely fill the intermediate part 7 of the casing. The slat-frames 60 are inserted into or removed from the intermediate casing part 7 through its open front when the service door 24 is removed which facilitates the initial assembly of the packing and the cleaning, servicing or repairing of parts.

Each individual slat-frame 60 comprises a plurality of wooden slats 61 arranged horizontally in spaced relationship on one side of vertical supporting strips 62 and 63. The slats 61 are connected to the supporting strips 62 and 63 by means of nails or screws 64 to provide a comparatively rigid slat-frame unit. Thus, the plurality of slats 61 of each frame 60 are positioned one above the other so that liquid will flow by gravity down the sides of each slat and onto the next lowermost slat. The lower edge of each slat 61 is serrated or notched to provide a series of adjacent drip-forming projections 65 for uniformly distributing the liquid as it flows from the slat. Liquid flowing down the sides of the slats 61 runs onto one or the other of the inclined sides of the drip-forming projections 65 and continues to flow to the lower end of the projections. After a sufficient amount of the liquid accumulates at the end of a projection 65, it will drip from the slat 61 onto the top of the next lowermost slat. At the places where the slats 61 are joined to the vertical supporting strips 62 and 63 the notches 66 are made deeper to counteract the tendency of the liquid to run down the supporting strips. With such a construction of drip-forming projections 65 and notches 66 at the lower edges of the slats 61 the liquid will be uniformly distributed throughout the length of the slats and prevent the flow of liquid in localized streams. For the purpose of uniformity in manufacture, each slat-frame 61 is provided with two sets of deep grooves 66 and 66' so that the supporting strips may be staggered in alternate frames as next explained.

To provide for swelling of the individual slat-frames 60 without expansion of the assembled

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packing which might otherwise burst the relatively rigid casing part 7, the vertical supporting strips 62 and 63 of each frame are laterally offset from the vertical supporting strips of adjacent frames. As illustrated in Fig. 4 the supporting strip 62 of the foremost slat-frame 60 is located nearer the center line C—C than the strip 63 while the supporting strip 63' of the next adjacent slat-frame 60' is nearer the center line than the strip 62'. Thus, the alternate slat-frames 60 have vertical supporting strips 62 and 63 arranged in alignment and offset at one side of a center line through the packing while the alternate slat-frames 60' have the supporting strips 62' and 63' arranged in alignment and offset at the other side of the center line. As the wooden slats 61 and supporting strips 62 and 63 are wetted they may swell, but due to the offset staggered relationship of the supporting strips the slats 61 of the individual slat-frames 60 may warp or bend slightly between the strips to take up the expansion without transmitting any force against the end panels of the intermediate housing section 7.

By providing each slat 61 with a plurality of sets of deep notches 66 and 66', the same slats 61 may be used to fabricate the alternate sets of slat-frames 60 and 61'. Preferably the slat-frames 60 are arranged in reverse order from the center of the intermediate casing part 7 so that the supporting strips 62 and 63 will engage the end panels at opposite ends of the packing assembly. With such an arrangement the two slat-frames 60 at the center of the casing will have the slats 61 in face to face relationship. One form of the invention having now been described in detail, the mode of operation of the cooling tower and the assembly of the packing is explained as follows.

When the cooling tower is initially assembled the slat-frames 60 are inserted into the intermediate part 7 of the casing through its open front and mounted in side by side relationship therein on the supporting beams 22. When assembling the packing the slat-frames 60' are arranged alternately with slat-frames 60 so that the supporting strips 62' and 63' will be offset laterally from the supporting strips 62 and 63 of adjacent frames as illustrated in Fig. 4. The slat-frames 60 and 60' are of a width corresponding to the depth of the intermediate part 7 of the casing and the assembly of individual slat-frames extends from one end to the other to completely fill the casing part. After the intermediate casing part 7 has been filled with slat-frames 60 and 60' the service door 24 is mounted in place on the casing to close the open front. The enclosed packing then forms a series of vertical rows of spaced horizontal slats 61 with the rows of slats held in spaced relationship by the staggered supporting strips 62, 62' and 63, 63'.

Water to be cooled is delivered to the cooling tower through the pipe 37, branches 38 and spray nozzles 39 in the form of a spray uniformly distributed over the top of the packing. Simultaneously, air is drawn into the cooling tower through the air inlet openings 29 by the induction fans 31, flows upwardly through the slat frames 60 and 60' of the packing and is discharged through the outlet openings 30. The water sprayed from the nozzles 39 descends onto the top slats 61 of the slat-frames 60 and 60' of the packing and flows by gravity down the sides of the slats in a thin film to the drip-forming projections 65 at their lower edges. The water drips from the projections 65 onto the top of the next lowermost

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slats 61 and continues to flow by gravity over each successive slat of the slat-frames 60 and 60' from the top to the bottom of the packing. Due to the drip-forming projections 65 and inverted V-shaped notches 66 of slats 61 the water is uniformly distributed throughout the packing and does not run through the packing in localized streams. Water from the lowermost slats 61 of the plurality of slat-frames 60 and 60' drips onto the splash baffles 51 and 53 and runs into the pool of water in the sump tank 13 without noise. As the slats 61 and supporting strips 62, 62' and 63, 63' become wet they tend to swell but due to the staggered relationship of the strips the slats may bend so that no appreciable force is transmitted to the ends of the casing.

As the water flows in thin films over the slats 61 of the slat-frames 60 or 60' a portion of the water is evaporated into the stream of air flowing through the packing. The heat of vaporization is abstracted from the unevaporated water which reduces its temperature to a value approaching the wet bulb temperature of the air entering the cooling tower. The cooled water in the sump tank 13 is drawn into the suction pipe 41 by the circulating pump 43 and delivered through the outlet pipe 45 to the appliance to be cooled, such as the condenser and absorber of an absorption refrigeration system, and then back to the distributing pipe 37.

When it is desired to clean, service or replace the slat-frames 60 and 60' of the packing, or clean or paint or service the interior of the cooling tower or nozzle 39, the service door 24 is removed from the front of the casing. As the service door 24 covers substantially the entire front of the intermediate casing part 7, its removal permits access to all parts of the interior of the casing. As the door has a greater dimension than the length of the slat-frames 60 and 60' the latter may be removed through the door opening for repair or cleaning. Sufficient space is also available above the slat-frames 60 and 60' to provide access to the spray nozzles 40. Also with the service door 24 removed it is possible to inspect the packing and spray nozzles when the tower is in operation. To replace the door 24 it is only necessary to insert its lower end into the forwardly offset flange of the lower cross piece 21, rock the door forwardly and insert the wing bolts 26.

Similarly, the air screen and splash baffle assemblies may be withdrawn from the air inlet openings 29 for cleaning or repair and the sump tank 13 may be removed by merely disconnecting the suction pipe 46 from the pump 43.

It will now be observed that the present invention provides an improved packing for a cooling tower which provides a large surface area for evaporation of liquid and insures uniform distribution of the liquid over the entire surface area. It will also be observed that the present invention provides a packing assembly of individual slat-frames which may be easily inserted into or removed from the casing for cleaning, servicing or repairing of parts. It will still further be observed that the present invention provides a construction and arrangement of wooden slat-frames so as to permit swelling or expansion of the individual frames without longitudinal expansion of the packing assembly.

While a single embodiment of the invention is herein illustrated and described, it will be understood that modifications may be made in the construction and arrangement of elements without

départing from the spirit or scope of the invention. Therefore, without limiting myself in this respect, the invention is defined by the following claims:

I claim:

1. A cooling tower comprising an upright casing having spaced end walls and a support extending therebetween, means in the casing for supplying liquid to be cooled, a sump below the liquid supplying means, air inlet and outlet openings in the casing, and a packing assembly in the casing between the liquid supplying means and sump comprising a series of individual slat-frame units, each of said units comprising a group of slats secured to and carried on a set of supporting strips, said slat-frame units resting side by side on said support with the supporting strips of each slat-frame unit contacting the slats of the next adjacent unit throughout the space between said end walls to mutually support each other in upright position, said supporting strips holding the slats of adjacent frames in spaced relationship and the supporting strips of each frame being offset with respect to supporting strips of adjacent frames whereby to permit flexing of the slats between supporting strips and thereby preventing bulging on the end walls of the casing upon swelling of the individual slat-frames.

2. A cooling tower comprising an upright casing having spaced end walls and a support extending therebetween, means in the casing for supplying liquid to be cooled, a sump below the liquid supplying means, air inlet and outlet openings in the casing, and a packing assembly in the casing between the liquid supply means and sump comprising a series of individual wooden slat-frame units, each of said slat-frame units comprising a plurality of horizontal slats mounted in spaced relationship on vertical supporting strips, said slat-frame units resting in abutting side by side relationship throughout the space between the end walls so as to mutually support each other in an upright position, and the supporting strips of adjacent slat-frame units being staggered to permit swelling of the frames without expansion of the packing in the casing.

3. A cooling tower comprising an upright casing having spaced end walls and a support extending therebetween, means in the casing for supplying liquid to be cooled, a sump below the liquid supplying means, air inlet and outlet openings in the casing, and a packing assembly in the casing between the liquid supply means and sump comprising two sets of individual wooden slat-frame units, each of said slat-frame units having a plurality of horizontal slats mounted in spaced relationship on vertical supporting strips, the vertical supporting strips of one set of slat-frame units being positioned at a different distance from the ends of the slats than the supporting strips of the other set of frames, and the slat-frame units of said sets being arranged alternately in said packing and resting in side by side abutting relation on said support throughout the width of the casing between the end walls to mutually support each other in an upright position whereby to permit swelling of the frames without expansion of the packing in the casing.

4. A cooling tower comprising an upright casing, means in the upper part of the casing for

supplying liquid to be cooled, a sump at the lower part of the casing for receiving cooled liquid, air inlet and outlet openings in the casing, and a packing assembly in the casing between the liquid supplying means and sump comprising a series of individual slat-frame units arranged in abutting side by side relationship to mutually support each other in an upright position, each of said slat-frames having a plurality of slats mounted in spaced relationship on supporting strips, said supporting strips holding the slats of adjacent frames spaced from each other and each of said slats having notches to provide drip forming projections for uniformly distributing the liquid as it flows therefrom onto the next lowermost slat and larger notches overlying the supporting strips to direct liquid away from the strips.

5. An individual slat-frame unit for a cooling tower comprising slats permanently mounted in parallel spaced relationship on one side of supporting strips, the supporting strips being located at unequal distances from the center of the slats, said slats having lower edges with notches therein to provide a plurality of drip forming projections, and said slats having enlarged notches overlying the supporting strips, the sloping edges of the slats formed by the enlarged notches leading away from the strips.

6. A cooling tower comprising a generally rectangular casing having parallel end walls and a support extending therebetween, means in the casing for supplying liquid to be cooled, a sump below the liquid supplying means, air inlet and outlet openings in the casing, and a packing assembly resting on the support in the casing between the liquid supplying means and sump comprising a series of individually removable slat-frame units in side by side abutting relation throughout the width of the casing between the end walls to mutually support each other in vertical arrangement, each slat-frame having a plurality of slats arranged in spaced relation and permanently attached to supporting strips, said supporting strips holding the slats of adjacent frames in spaced relation and the strips in adjacent frames being offset with respect to each other to permit flexing of the slats to compensate for swelling of individual frames, and the bottom edge of each slat being notched to provide a plurality of adjacent drip forming projections.

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