L. D. LOVEKIN.

FLUID HEATER AND COOLER.

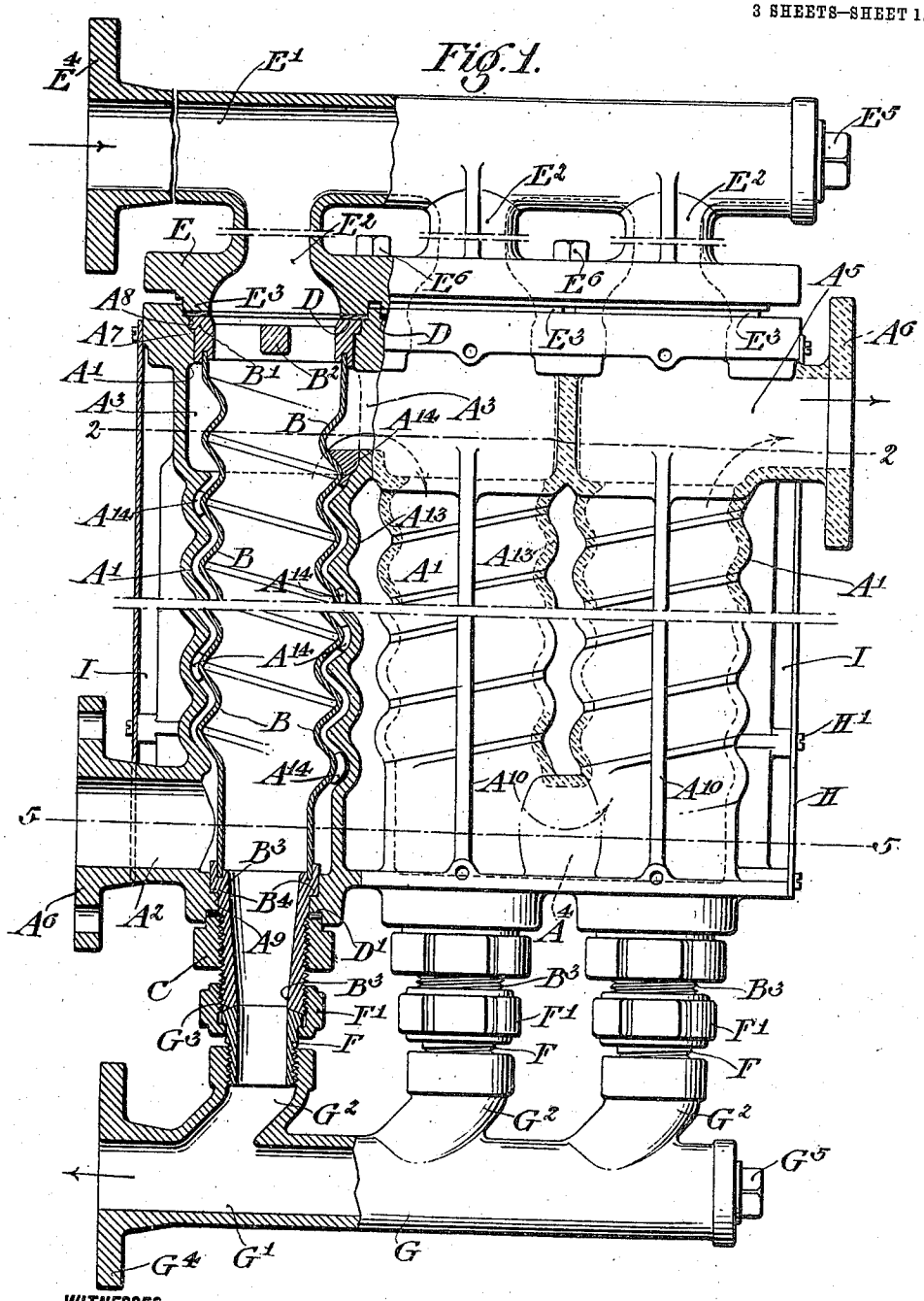
APPLICATION FILED MAY 1, 1909.

983,914.

Patented Feb. 14, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 2.

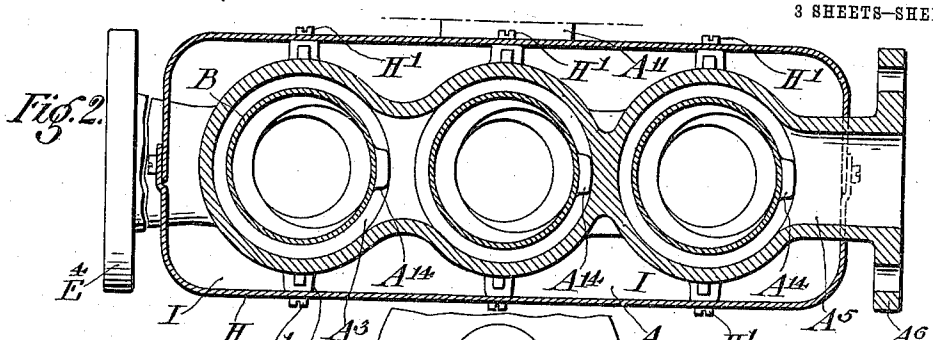
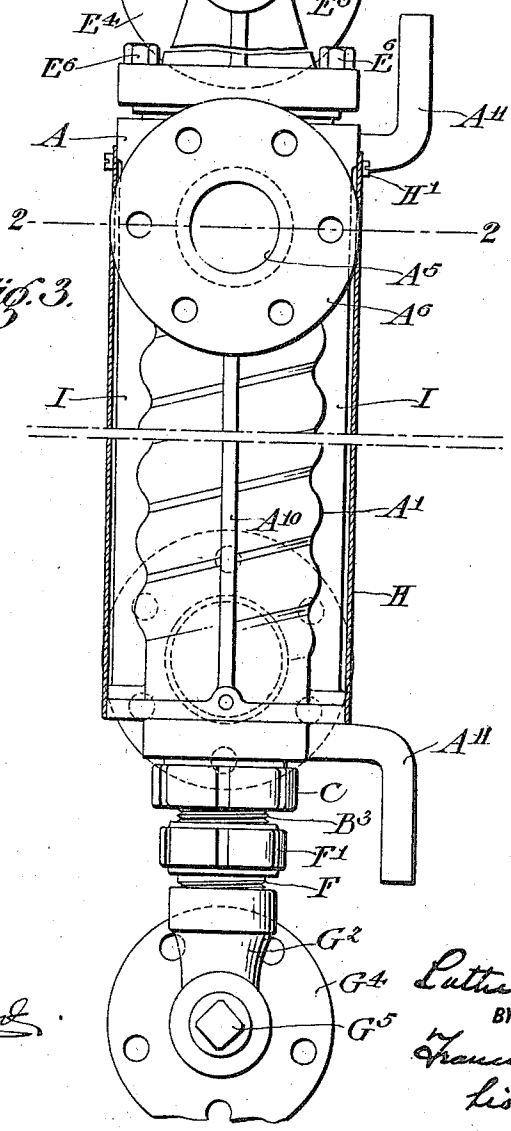


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 4.

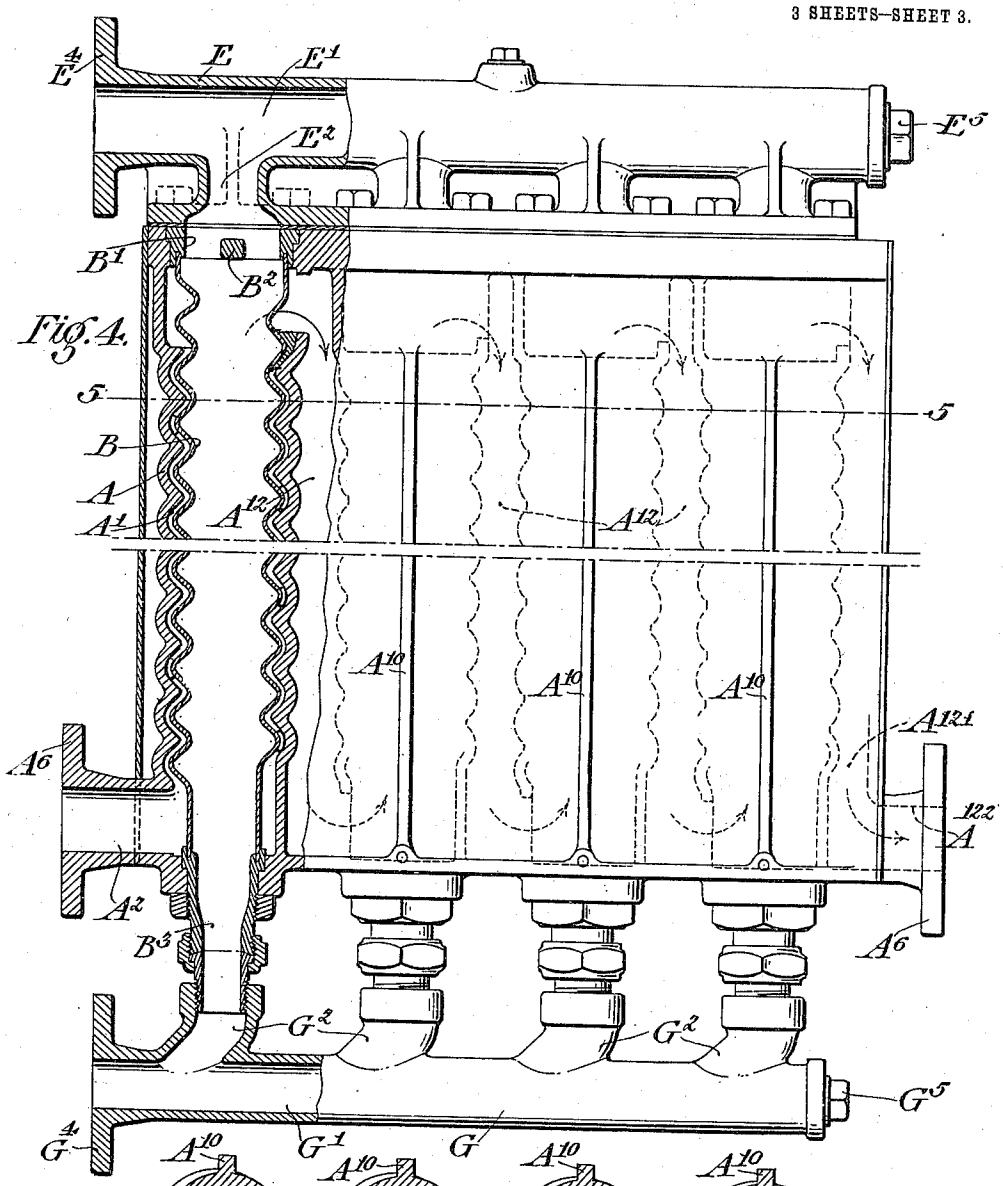
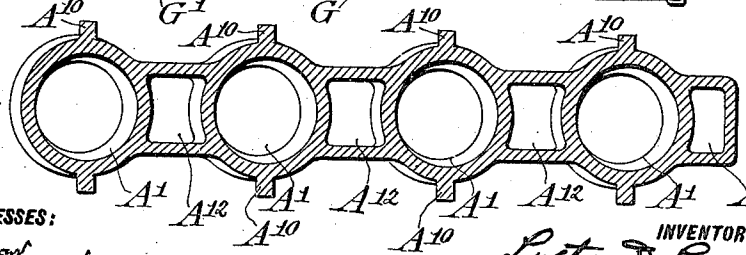


Fig. 5



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FLUID HEATER AND COOLER.

983,914. Specification of Letters Patent. Patented Feb. 14, 1911.

Application filed May 1, 1909. Serial No. 493,278.

To all whom it may concern:

Be it known that I, LUTHER D. LOVEKIN, a citizen of the United States of America, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a certain new and useful Improvement in Fluid Heaters and Coolers, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My present invention relates to devices of the kind in which provisions are made for the flow of two separate fluids of different temperatures in proximity to each other in such manner that heat is transferred from one fluid to the other.

The general object of the present invention is to provide a device of the kind specified which is simple and relatively inexpensive to manufacture, which is compact, and which is efficient and durable in operation.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention, and its advantages and specific objects, reference may be had to the accompanying drawings and descriptive matter in which I have illustrated and described forms in which the invention may be embodied.

Of the drawings, Figure 1 is a side elevation, partly broken away and in section, of one device embodying my invention. Fig. 2 is a sectional plan taken on the line 2—2 of Figs. 1 and 3, and looking upward. Fig. 3 is an end elevation of the device shown in Fig. 1. Fig. 4 is a view, generally similar to Fig. 1, showing a construction differing in some respects from that shown in Figs. 1, 2 and 3. Fig. 5 is a sectional plan taken on the line 5—5 of Fig. 4, with the inner tubes removed.

In the drawings, and referring first to the construction shown in Figs. 1, 2 and 3, A represents the main member or body of the heater. The member A is a flat structure generally rectangular in outline, and consists of a one piece casting having formed in it a plurality of tubular passages A′ which extend between an opposite pair of side edges of the member A. In the form shown there are three passages A′, but the number of these passages is immaterial, and in some cases it may be desired to have a much greater number of passages A′. The passage A′ adjacent one edge of the member A has one end in communication with an inlet port A^2 for the liquid to be heated, and has its other end connected by a port or channel A^3 to the end of the middle passage A′. Similarly, the other end of the middle passage A′ is connected by a port or channel A^4 to the corresponding end of the second outside passage A′, and the opposite end of the latter is connected to the outlet port A^5. Flanges A^6 for pipe connections are provided about the outer ends of the inlet and outlet ports A^2 and A^5 respectively.

Tubular members B are provided which pass through but do not fill the passages A′ except at their ends. The openings A^7 at the ends of the passages A′ at one edge of the member A are filled by the end portions B′ of the members B. Each end portion B′ may be in the form of a metal collar brazed, or otherwise secured, to the end of the corresponding member B, and is provided at its upper edge with an external collar or rib adapted to fill and seat against the shoulder formed by the bottom of an enlargement A^8 of the outer end of the corresponding opening A^7. The member A is similarly provided at its opposite edge with openings A^9, one in line with each tubular passage A′ into which extend the end portions B^3 of the members B. The end portions B^3 may preferably be tubular pieces of metal heavier in cross section than the tubes B proper, and each may be secured to the corresponding tube by brazing. In the construction illustrated, each end portion B^3 is provided with a collar or rib B^4 at its inner end which abuts against a seat formed by enlarging the inner end of the opening A^9 in member A through which the end portion B^3 extends. The outer end of each end portion B^3 is externally threaded and engaged by a nut C by which the end portion is clamped in place. The nut C has a reduced portion which enters a recess formed in the outer surface of the member A and bears against a packing washer D′, received within that recess, thereby making a tight joint.

A member E, having a channel E′ for conveying steam, or other heating fluid, to the upper ends of the tubes B, is clamped against the upper side or edge of the mem-

ber A by bolts E^6 and is provided with a series of branch ports or channels E^2 which lead each from the passage E′ to the outer end of one of the tubes B. In the form shown in Figs. 1, 2 and 3, each port E^2 is surrounded by a boss E^3 which bears against the outer end of the end portion B′ of the corresponding tube B. By preference, as shown, each boss E^3 enters a recess formed for the purpose in the outer wall of the member A. By preference, also, a washer D is inserted between the inner edge of each boss E^3 and the corresponding tube end portion B′ to insure a tight joint.

The member E is provided at one end with a flange E^4, or like device, for connecting the steam supply pipe thereto. The other end of the passage E′ is provided with a plug E^5 which may be removed to permit a thermometer tube to be inserted in the passage E′.

A member G, having parts G′, G^2, G^3, G^4 and G^5 generally similar to the parts E′, E^2, E^3, E^4 and E^5, respectively, of the member E, has its branch ports, or channels, G^2 connected to the lower end portions B^3 of the tubes B. In the case of the member G, however, the branches G^2 are internally threaded to receive threaded coupling members F which are clamped against the ends of the end portions B^3 by nuts F′.

The walls of the tubular passages A′ are surrounded by a casing H which fits over ribs A^{10} provided on the member A and is secured in place by screws H′ tapped into the member A. The space within the casing H and surrounding the member A proper may be filled with any suitable heat insulating material I to prevent radiation of heat from the device.

Bracket arms A^{11} may be provided at the top and bottom edges of the member A for securing the heating device in place against a wall or other support.

In the construction illustrated, the wall surrounding each tubular passage A′ is in the form of a spirally corrugated tube, and each tubular member B is spirally corrugated and of the same pitch as the corrugation in the wall of the passage A′, and the distance between the outer wall of each tube B and the inner wall of the corresponding passage A′ is less than the depth of the corrugation in either tube. By this means a film like space, of relatively large aggregate surface area, is provided between each tube B and the wall of the corresponding passage A′, while at the same time each tube B, when its end connections are loosened, may be threaded into place in assembling the heater as described and claimed in my prior Patent No. 904,627, granted Nov. 24, 1908.

Preferably also, the end connections for the tubes B are in the forms shown, since the opening of the member A, receiving each end portion B′, is larger than the maximum diameter of the tube B, and the maximum diameter of the end portion B^3, is less than the minimum diameter of the passage A′. The parts, after being assembled, may be readily disassembled and reassembled, whenever necessary, for inspection, cleaning, or repairs, but no claim is made herein to the features of construction referred to in this paragraph, as they form the subject matter of my prior application Serial No. 463,962, filed Nov. 23, 1908. It may be remarked that the cross piece B^2 of each end portion B′ is provided to form a handle by which the tube B may be threaded into and out of place.

Preferably, means are provided for spacing each tube away from the walls of the inclosing passage A′. For instance, lugs or projections A^{14} may be brazed or otherwise formed on the inner wall of each passage. By placing one or more of these lugs adjacent the upper end of each passage A′, the operation of screwing the corresponding tube into and out of place serves to clean it.

In the construction illustrated it will be observed that each convolution of the external rib A^{13} on the wall of each tubular passage A′ nests with the convolutions of the corrugation A^{13} on the external surface of the wall of the adjacent passage A′. This permits the passages A′ to be brought closely together and compactly arranged, while at the same time it permits of sufficient space between the walls of adjacent passages A′ to prevent undesired heat transmission between them. It will be apparent, however, to those skilled in the art that the heating or cooling device disclosed herein possesses numerous important features which are in nowise dependent upon the corrugated form of the members B or the walls of the passages A′ or the character of the end connections of the tubes B.

Among the advantages of the device are its compactness as a whole, and its relatively flat or thin form in which it resembles the ordinary steam or hot water radiator, and, like such a radiator, is adapted to be unobtrusively disposed against a wall or in other localities where only a small space is available. The compactness of the device and its form particularly fits it for use on shipboard and in places where the available space is limited.

The construction illustrated in Figs. 1, 2, and 3 is primarily adapted for use where the heating fluid is steam, the steam entering the passage E′, and the condensed steam passing out through the passage G′. The fluid to be heated, as for instance feed water, is admitted at A^2 and discharged at A^5 and, as pointed out, passes upward through one side passage A′, down through the interme-

diate passage A′ and up through the other outside passage A′.

Since the general flow of the heating fluid is downward, the heating effect within the intermediate passage A′ is less advantageous, according to well known principles, than it would be if the flow of the fluid to be heated through the intermediate passages were upward instead of downward. While in devices of relatively small size this matter is not very important it becomes important in relatively large size devices where high effectiveness is desired.

In the construction shown in Figs. 4 and 5 where the flow of the heating fluid is downward through each tube B as before provision is made for obtaining an upward flow of the fluid to be heated through each of the tubular passages A′. The construction shown in Figs. 4 and 5 differs principally from that in Figs. 1, 2 and 3 in that a channel or elongated port A^{121} is provided at the outer side of the particular passage A′ which is closest to the outlet port for the fluid to be heated, and a similar port A^{12} is provided between each pair of passages A′. Each passage A^{12} and the passage A^{121} is connected at its upper end to the corresponding end of the passage A′ at its left. Similarly, each passage A^{12} is connected at its lower end to the lower end of the passage A′ at its right. The outlet end A^{122} of channel A^{121} is located on the same level as the inlet A^2.

Certain features of invention which are disclosed but not claimed herein are claimed in my other application Serial No. 493,277 filed of even date herewith.

While, in accordance with the provisions of the statutes, I have herein described and illustrated the best forms of the device now known to me, it will be apparent to those skilled in the art that changes may be made in the form of my invention without departing from its spirit, and I do not wish the claims hereinafter made to be limited to the particular forms disclosed more than is made necessary by the state of the art.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is:

1. In a fluid heater or cooler, the combination of a one piece casting formed with a plurality of passages, each open at its opposite ends and with channels or ports connecting said passages adjacent their ends, and a series of tubes, one extending through each of said passages and closing the ends thereof but with its body portion of less cross sectional area than the passage through which it extends.

2. In a fluid heater or cooler, the combination of a one piece casting formed with a series of passages, each open at its opposite ends, and with a port leading from one end passage of said series adjacent one end of the passage and another leading from the other end passage of the series adjacent one end of the latter, and with channels connecting each intermediate passage adjacent one end with one neighboring passage, and adjacent the other end with another neighboring passage, and a series of tubes one extending through each of said passages and closing the ends thereof but with its body portion of less cross sectional area than the passage through which it extends.

3. In a fluid heater or cooler, the combination of a flat structure rectangular in outline formed with a plurality of parallel passages extending between the opposite side edges of said structure and with channels or ports connecting said passages adjacent their ends, and a series of tubes, one extending through each of said passages and closing the ends thereof, but with a body portion of less cross sectional area than the passage through which it extends.

4. In a fluid heater or cooler, the combination of a flat one piece structure rectangular in outline formed with a plurality of parallel passages extending between the opposite side edges of said structure and with channels or ports connecting said passages adjacent their ends, and a series of tubes, one extending through each of said passages and closing the ends thereof, but with a body portion of less cross sectional area than the passage through which it extends.

5. In a fluid heater or cooler, the combination of a flat structure rectangular in outline formed with a plurality of parallel passages extending between opposite side edges of said structure and open at their opposite ends, and with channels or ports connecting said passages adjacent their ends, and a series of tubes, one extending through each of said passages and closing the ends thereof, but with a body portion of less cross sectional area than the passage through which it extends, the wall of each passage being in the form of a spirally corrugated tube with the corrugation rib of each tube nesting in the external corrugation groove of an adjacent tube.

6. In a fluid heater or cooler, the combination of a flat one piece casting formed with a series of parallel passages, said member having openings at one edge, one at the end of each of said passages and having each opening enlarged at its outer end to provide an annular shoulder surrounding the body of the opening, tubular members, one passing through but not filling each of said tubular passages, and each having an end portion provided with a rib adapted to seat on the said annular shoulder of the corresponding opening, and a one piece end member detachably clamped against said one edge of said structure and engaging the end portions of said tubular members to hold them in

place, said end members being formed with a channel extending parallel to said one edge and with ports or branch passages connecting said channel with the interiors of the various tubular members.

7. In a fluid heater or cooler, the combination of a structure formed with a series of parallel passages, each open at its opposite ends, and with a series of channels arranged to connect the various passages together in series, each of said channels being connected to two passages, with one passage, adjacent one end of the structure and with the other passage adjacent the opposite end of the structure, connections by means of which a fluid may be passed in series through said passages and channels, a series of tubes, one extending through each of said passages and closing the ends thereof, but with its body portion of less cross sectional area than the passage through which it extends, and connections by means of which a fluid may be caused to flow in the same direction through all of said tubes one after another.

8. In a fluid heater, comprising a casting of flat generally rectangular shape, formed with parallel passages extending through it, and with ports and channels connecting the ends of said passages together so that a fluid may pass in series through all of said tubular passages, tubular members arranged in but not filling the said tubular passages, each of said tubular members being rigidly secured at both ends to said casting, and pipe connections whereby a fluid for cooling or heating may be passed through said tubular members.

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Witnesses:
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