

April 30, 1963

L. SCHOMANN

3,088,017

ELECTRIC CONTINUOUS-FLOW HEATER

Filed Dec. 15, 1958

3 Sheets-Sheet 1

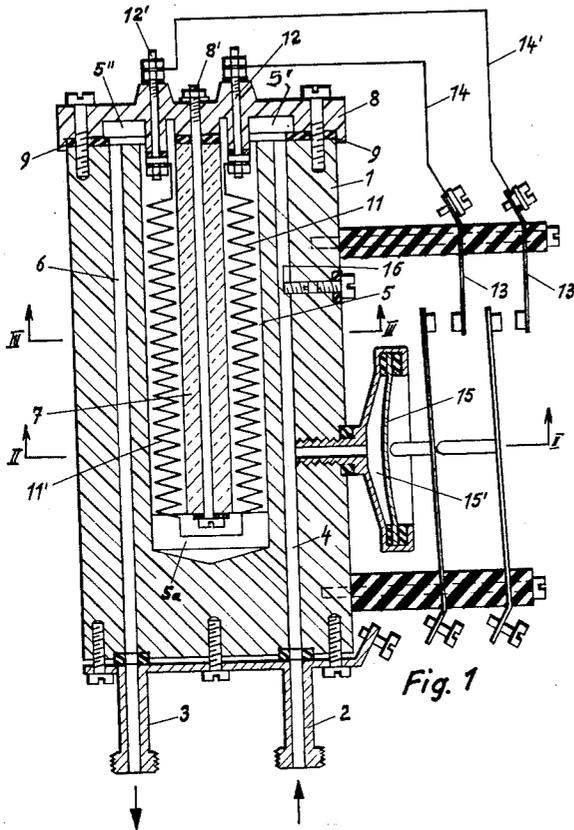


Fig. 1

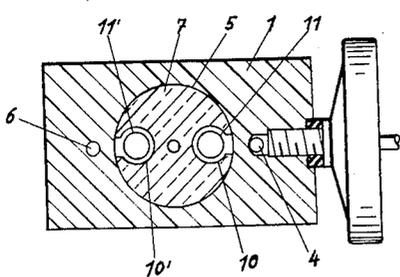


Fig. 2

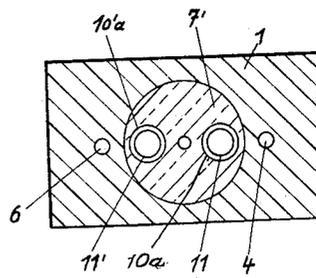


Fig. 3

INVENTOR.

Leonid Schomann,

BY

Jones, Darbo & Robertson,
Attys.

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Fig. 6

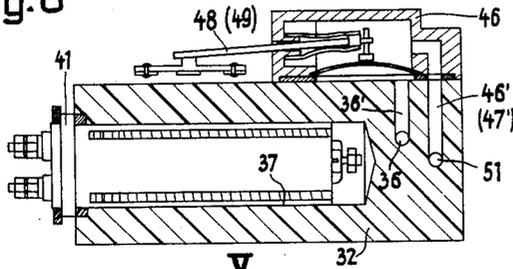


Fig. 5

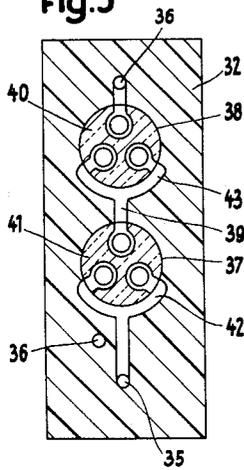


Fig. 4

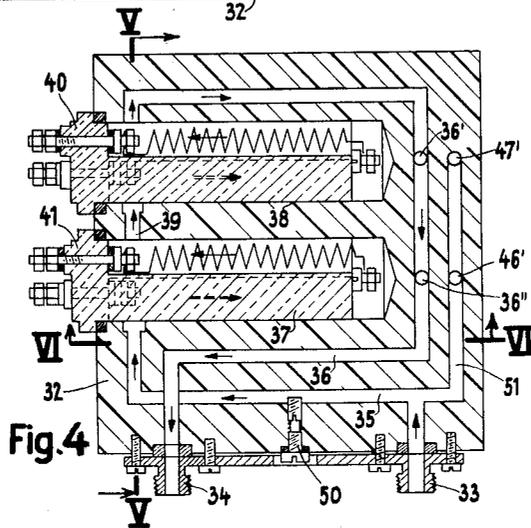


Fig. 8

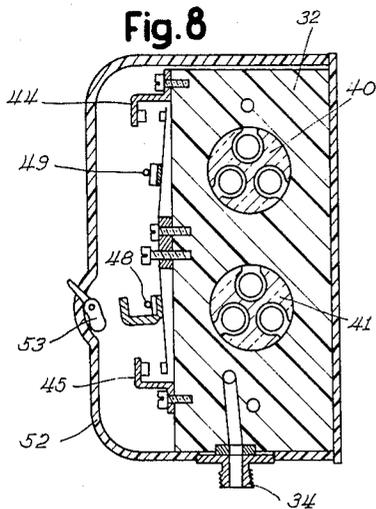
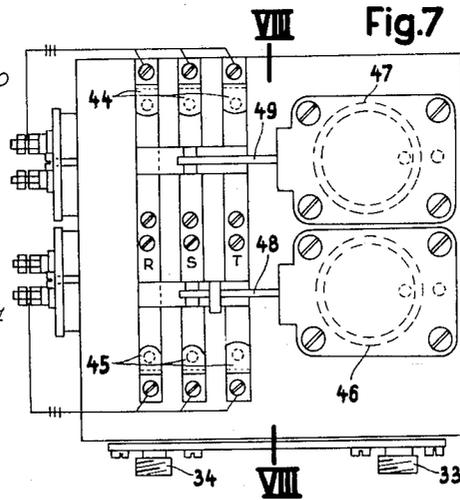


Fig. 7



INVENTOR.

Leonid Schomann,
BY
Jones, Darbo & Robertson,
Attys

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L. SCHOMANN

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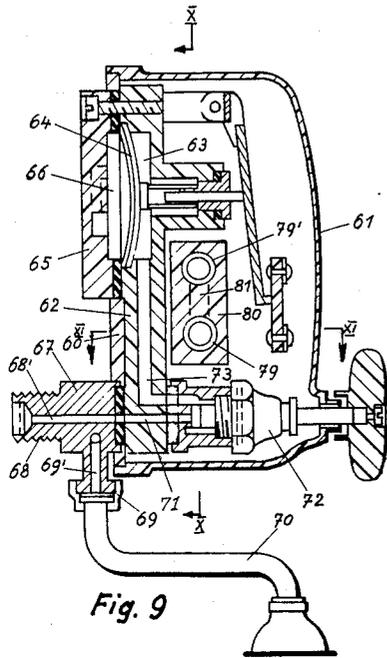


Fig. 9

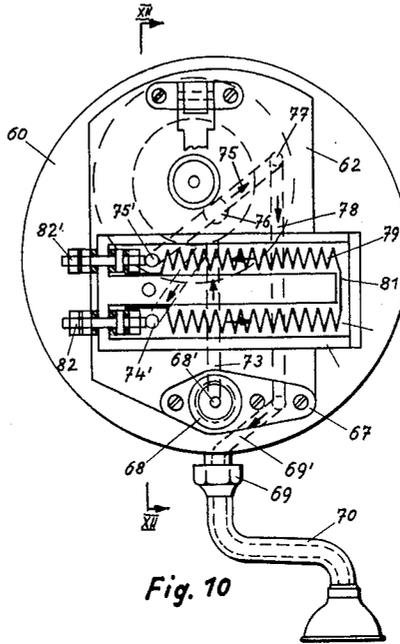


Fig. 10

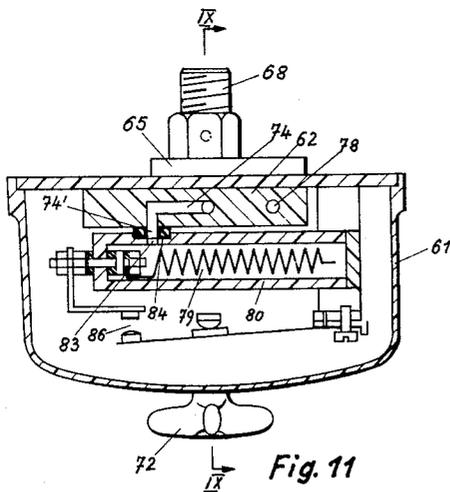


Fig. 11

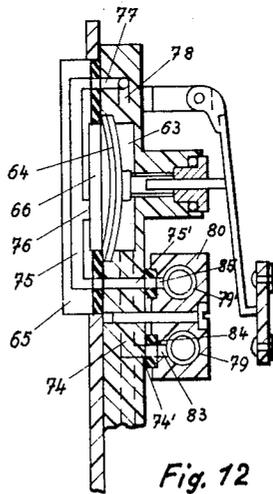


Fig. 12

INVENTOR.

Leonid Schomann,

BY

Jones, Darbo & Robertson,
Attys.

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3,088,017

ELECTRIC CONTINUOUS-FLOW HEATER

Leonid Schomann, Langenberg, Rhineland, Germany, assignor to Alfred Eckerfeld, Essen, Ruhr, Germany
 Filed Dec. 15, 1958, Ser. No. 780,435
 Claims priority, application Germany Dec. 14, 1957
 10 Claims. (Cl. 219—39)

This invention relates to an electric continuous-flow heater comprising a heating channel through which water is circulated, and in which a heating coil is arranged which comes directly into contact with the water to be heated.

It is well known in the art relating to such electric continuous-flow heaters (German Patent 440,145) to arrange resistance channels, which have a smaller diameter than the heating channel, in front and behind the heating channel in order to form an electric water column resistance. With the conventional type continuous-flow heaters of this kind, a ceramic insertion element comprising the heating channels and the resistance channels has been used which is inserted as an exchangeable structural part in an apparatus housing. The inlet and the discharge connection as well as the terminals for the heating coils are provided on the apparatus housing. If replacement of the heating coil becomes necessary with the conventional type of apparatus, this requires a complete stripping down of the apparatus in order to be able to insert a new relatively complicated insertion element, which comprises many channels, and to connect the heating coil.

It is therefore the object of the invention to provide an electric continuous-flow heater operating in accordance with the above described principle, but which is simpler in its structural setup and more appropriately designed, so that an easy exchange of the heating coil and convenient cleaning of the heating channels becomes possible without the necessity for disassembling the apparatus.

According to the invention, this object is accomplished by arranging the resistance channels provided in front and behind the heating channel within a block shaped base element supporting the connection sockets, while the heating channels with the heating coils arranged in said heating channels and the terminals of the heating coils are arranged to form an integral heating element sub-assembly that can be detached from the aforementioned base elements. The heating channels of the heating element are sealingly connected with the resistance channels provided in the base element when these two elements are assembled.

The present invention is concerned not with merely inserting a heating cartridge which is designed in accordance with the principle of an immersion heater and which has a heating coil that is electrically insulated from the water. In the improved continuous-flow heater conceived and constructed in accordance with the present invention, the water passage is, rather, separated, so that a portion of the water passes through the base element and a portion through the heating element which can be removed from the base element.

The continuous-flow heater according to the invention is advantageously so designed that the resistance channels communicate with a recess or well provided in the base element, in which recess the heating element can be inserted as an easily removable insertion element, and in which it is fitted and sealed from the outside. In order to simplify the cleaning of the heating channels, the heating coils may be fitted into open grooves of the insertion element or body, these grooves forming closed heating channels together with portions of the wall surface of the recess provided in the base element. Various insertion elements having equal outer dimensions but which are

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provided for different heating efficiencies can then be fitted into the same base elements. Since the terminals for the heating coil are also mounted on the insertion element, the heating coils remain connected to their terminals when the insertion element is removed. The insertion element is relatively small in size and therefore needs no sealing faces because it contains only the heating channels, but does not contain the resistance channels.

In a further development of the idea of the invention, several heating elements having heating coils that can be switched on independently of each other are connected in a detachable manner with a common base element comprising the resistance channels and connection ducts. In this manner it is possible to construct dual heating element apparatus which may be operated at full or half load as desired. Since continuous-flow heaters of this type are frequently connected to three-phase mains, it is advantageous to provide an insertion element having three parallel heating channels with heating coils arranged in each of these channels, and to provide a recess or channel in the base element at the one end of the insertion element in order to establish a connection between two of the heating channels. The three heating coils of the insertion element may be connected with each other on one side by a star-delta connection.

As an alternative design, the continuous-flow heater according to the invention may be so constructed that the heating element too has a block like shape, and is in sealing contact with the front surface of the base element into which the resistance channels open, and where the connection openings leading to the heating channels communicate with the ends of the resistance channel openings. This arrangement makes it possible to use an elastic sealing disk also functioning simultaneously as a throttling disk for sealing the connection between the resistance channel opening and the connection opening.

Three embodiments of the invention are more fully described in the following detailed description wherein reference is made, particularly, to FIG. 1 of the accompanying drawings.

In the drawings:

FIG. 1 is a continuous-flow heater according to the invention in sectional elevation,

FIG. 2 is a section taken on the line II—II of FIG. 1,

FIG. 3 is a section taken on the line III—III of FIG. 1 showing a modified form of the heating element,

FIG. 4 shows a dual heating element apparatus conceived and constructed according to the invention in sectional elevation,

FIG. 5 is a section taken on the line V—V of FIG. 4, FIG. 6 is a section taken on the line VI—VI of FIG. 4,

FIG. 7 shows the dual heating element apparatus in elevation,

FIG. 8 is a section taken on the line VIII—VIII of FIG. 7,

FIG. 9 shows a continuous-flow heater of alternative construction in sectional view according to the line IX—IX of FIG. 11,

FIG. 10 is a section taken on the line X—X of FIG. 9, FIG. 11 is a section taken on the line XI—XI of FIG. 9, and

FIG. 12 is a section taken on the line XII—XII of FIG. 10.

In the continuous-flow heater illustrated schematically in FIGS. 1 to 3, an inlet connection 2 and a discharge connection 3 are arranged at the base element 1, which latter is made from insulating plastic material. A resistance channel 4, which is inserted into the base element 1, leads from the inlet connection 2 to a recess 5' of a screw mounting plate 8. The recess 5' communicates with a large well 5 in the base element 1. A resistance

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channel 6 is provided in the base element 1 connecting recess 5" of the mounting plate 8, which also communicates with the well 5, to the discharge connection 3. A ceramic insertion element 7, which is fitted into the well 5 of the base element 1, is attached to the mounting plate 8 by means of a screw bolt 8'. The mounting plate 8 is sealed by means of an elastic sealing ring 9. The insertion element 7 has two groove shaped recesses 10, 10' which form closed heating channels together with wall surfaces of the well 5 of the base element. The heating channels 10, 10' communicate with each other through the space 5a which is provided beneath the insertion element 7.

The purpose of the electrical water column resistance channels, disclosed in German Patent No. 440,145, referred to above, is to prevent any substantial potential difference or current flow between the inlet and outlet of the water heater. Where electrical heating coils are used which are not insulated and which operate in contact with the water to be heated, an electrical potential is applied to the water columns at the coil ends. If the usual large diameter channel were to connect the inlet with the outlet, a dangerous amount of electrical current would be applied across the inlet and outlet, and the inlet and outlet could then not be grounded.

In the present arrangement, however, the long and relatively narrow water columns within the channels 4 and 6 operate effectively as protective electrical resistors having high ohmage values, so that only a minute current can flow between the connection sockets. If these sockets are now grounded in a conventional manner, only a very small current of a few milliamperes flows through the water column due to the low electrical current conductivity of the water. This small amount of current leak is not dangerous.

One heating coil 11, 11' is located in each of the heating channels 10, 10'. These heating coils are connected with each other and their free ends are connected to the terminals 12, 12'. The terminals 12, 12' penetrate the mounting plate 8, so that leads 14, 14', which are conducted outside the heating element to a switch 13 can be connected to these terminals. The switch 13 is operated by a diaphragm 15 cooperating with a diaphragm chamber 15' which is connected to the inlet resistance channel 4 in front of a throttling point 16.

With the continuous-flow heater described above, the water entering the apparatus flows through the resistance channel 4 and the recess 5' into the heating channel 10 and through the space 5a reaches the second heating channel 10'. From there, the water flows through the recess 5" into the discharge resistance channel 6 which leads to the discharge connection 3. A static pressure is produced in the diaphragm chamber 15' by means of the throttling point 16. This static pressure so produced actuates the switch 13 by means of the diaphragm 15. The heating coils 11, 11' are thereby switched on and the water flowing through the heating channels 10, 10' is heated.

The structural setup of the apparatus according to the invention offers the advantage that after unscrewing the mounting plate 8, the insertion element 7 can be withdrawn from the base element 1, so that access is given to the heating coils 11, 11' arranged in the groove shaped recesses to permit convenient cleaning or exchange of these heating coils. It is, of course, also possible—as shown in FIG. 3—to provide the heating channels 10a, 10a' as closed bore holes in the insertion element 7, the heating coils 11, 11' are then inserted into or withdrawn from the heating channels in axial direction.

A dual heating element apparatus intended to be connected to three-phase mains is illustrated in FIGS. 4 to 7. An inlet resistance channel 35 and a discharge resistance channel 36 are provided in a base element 32 of correspondingly larger size and which is fitted with an inlet connection 33 and a discharge connection 34.

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Further, two larger wells 37, 38 arranged in parallel to each other are provided in the base element 32 and which are connected with each other through a duct 39. Insertion elements 40, 41 of the type and construction described, each of which contains three heating channels fitted with heating coils, are inserted into the wells 37, 38 of the base element 32. Recesses 42, 43 are provided to ensure that in each case two of the three heating channels are traversed by the water flowing in the same direction. The passage of the water is indicated by the arrows shown in the drawings.

The three star-delta connected heating coils of each insertion element 40, 41 are connected to switch contacts 44, 45 cooperating with switch springs RST of the three-phase current mains. The switch springs RST are actuated by two diaphragm switches 46, 47 arranged in side-by-side relationship on the base element 32 and through transmission members 48, 49, so that the heating coils of the two insertion elements 40, 41 can be switched on separately, i.e., independently of each other.

Each of the two diaphragm switches 46, 47 has two diaphragm chambers in which a dynamic differential pressure becomes effective as soon as water flows through the apparatus. In order to generate this differential pressure, the inlet resistance channel 35 is throttled by means of an adjustable screw 50. The upper diaphragm chamber of the two diaphragm switches 46, 47 communicates through a connecting duct 46', 47' with a branch channel 51 of the base element 32, channel 51 branching from the inlet connection 33.

The lower diaphragm chambers of the diaphragm switches 46, 47 are connected to the discharge channel 36 through ducts 36', 36''. Consequently, the unthrottled pressure in the upper diaphragm chambers preponderates when water flows through, so that the diaphragm forced downwards and the tiltably mounted transmission members 48, 49 supported by the diaphragms can give way in upwards direction. The switch springs RST, which are held under spring tension in the switched-off position, are thereby released and switch on the heating coils of the two insertion elements 40, 41. It is possible by means of a lever 53, which is mounted on the shell 52 of the apparatus and which can be operated from the outside, to lock the transmission member 48 in its switched-off position, so that the switch contacts 45 of the one insertion element 41 cannot make contact, even if water flows through the diaphragm switch 46. It is thus possible to operate the apparatus with full or half heating power as desired.

Referring now to FIGS. 9 to 12 a circularly shaped continuous-flow heater conceived and constructed in accordance with the present invention is illustrated schematically.

A base element 62 is mounted on a circular plate 60 made from plastic material and which is covered by means of a casing cap 61. The base element 62 and the plastic plate 60 have a circular recess in their upper portion. A diaphragm 64 is inserted into the circular recess 63. The diaphragm 64 is held in position by means of a connecting piece 65 which is connected with the base element 62 and penetrates through the plastic plate 60. The recess 63 thus forms the front diaphragm chamber, while a rear diaphragm chamber 66 is formed between the diaphragm 64 and the connecting piece 65. A fitting 67, which comprises an inlet connection 68 with an inlet channel 68' and a discharge connection 69 with a discharge channel 69', is screwed to the base element 62. A swing arm discharge 70 is connected to the discharge connection 69. The inlet channel 68' communicates with a channel 71 of the base element 62, the latter channel 71 being governed by a tap valve 72 which is designed as a globe valve. When the tap valve 72 is opened, water is permitted to flow from the channel 71 into a resistance channel 73 of the base element 62 which

connects the tap valve 72 with the front diaphragm chamber 63. A duct 74, which may be considered a connection channel prolongating the resistance channel 73 and which is arranged in the base element 62, leads from the front diaphragm chamber 63 obliquely downwards. This duct 74 has an angular bend and an opening 74' on the front side of the base element 62. Above the opening 74' of the connection duct 74 lies the opening 75' of another resistance channel 75 which penetrates through the base element 62 and bends obliquely upwards in the connecting piece 65. The rear diaphragm chamber 66 is connected with the resistance channel 75 through a recess 76. The resistance channel 75 communicates with a channel 78 through a transverse duct 77. The channel 78 bends downwards in the base element 62 and leads to the discharge channel 69' of the fitting 67.

A block shaped heating element 80 provided with heating channels 79, 79', which are arranged in parallel to each other, is arranged in front of the base element 62 and fixed on the plastic plate 60. The heating channels 79, 79' communicating with each other on one side through a recess 81 accommodate heating coils, which are connected to terminals 82, 82' in a manner which has already been described above. A transverse bore hole 83 of the heating element 80, which faces the opening 74', establishes a connection between the connection channel 74 and the heating channel 79. An elastic sealing ring 84 is fitted between the base element 62 and the heating element 80. This sealing ring is designed as a throttling disk and has a passage opening of more or less width, which depends on the volume of water to flow through the apparatus. In similar manner—but, of course, without a throttling disk—there is established a sealed connection between the heating channel 79' and the resistance channel 75 through the transverse bore hole 85 provided in the heating element.

When the tap valve 72 is opened, water flows from the inlet channel 68' into the resistance channel 73 and into the front diaphragm chamber 63. From there, the water passes via the connection duct 74 through the throttling sealing ring 84 into the heating channels 79, 79' and then flows through the channels 75, 77 and 78 to the discharge channel 69'. With this course of water passage, a differential pressure is produced in well known manner in the diaphragm chambers 63 to 66, so that a switch 86 is actuated in well known manner by the diaphragm movement to make contact whereby the heating coils are switched on. The heating element 80 with the heating coils 79, 79' arranged in its heating channels can be detached without any difficulties from the base element 62 and exchanged or replaced if necessary. The course of the water passage described hereinbefore is reestablished when the heating element 80 is re-attached to the base element 62.

I claim:

1. An electric continuous-flow heater comprising a unitary one-piece base composed of an electrically insulating material having therein inlet and outlet electrical water column resistance channels; a heating element sub-assembly removably mounted on said base comprising a body member having a heating channel therein, an electrical heating coil arranged in said heating channel to permit water to circulate in contact with said heating coil, and electrical terminals mounted on said body member and being connected to said heating coil; and means for connecting said heating channel with said inlet and outlet resistance channels when said heater is assembled.

2. An electric continuous-flow heater comprising a unitary one-piece base composed of an electrically insulating material having inlet and outlet electrical water column resistance channels and a well therein, said resistance channels being connected to said well; a heating element sub-assembly having a portion thereof removably mounted in said well comprising a body member having

a heating channel therein, an electrical heating coil arranged in said heating channel to permit water to circulate in contact with said heating coil, electrical terminals mounted on said body member and being connected to said heating coil; means for connecting said heating channel with said inlet and outlet resistance channels; and means for sealing off the portion of said heating element sub-assembly contained in said well from the atmosphere.

3. An electric continuous-flow heater according to claim 2 wherein said heating channel is in the form of a groove communicating with the surface of said body element throughout its length, and wherein a portion of the wall of said well cooperates with said groove to form closed heating channels when said heater is assembled.

4. An electric continuous-flow heater according to claim 2 wherein said heating element contains three parallel heating channels each having a coil arranged therein, the wall of said well being provided with a channel for connecting together two of said heating channels.

5. An electric continuous-flow heater according to claim 4 wherein said three heating coils are electrically connected with each other at one side by a star-delta connection, and said terminals are arranged for connection to a three-phase current supply.

6. An electric continuous-flow heater comprising a unitary one-piece base composed of an electrically insulating material having inlet and outlet electrical water column resistance channels therein; a plurality of heating element sub-assemblies removably mounted on said base each comprising a body member having a heating channel therein, an electrical heating coil arranged in said heating channel to permit water to circulate in contact with said heating coil, means for connecting said heating channels in series with each other, and electrical terminals mounted on each of said body members and being so connected to said heating coils as to permit independent switching on of said heating coils; and means for connecting said heating channels with said inlet and outlet resistance channels when said heater is assembled.

7. An electric continuous-flow heater according to claim 6 having a throttling means arranged in one of said resistance channels, and having a pair of diaphragm switches connected one to the terminals of each of said heating elements, said diaphragm switches being responsive to the pressure difference across said throttling means.

8. An electric continuous-flow switch according to claim 6 having a throttling means arranged in one of said resistance channels, a diaphragm switch connected to the terminals of one of said heating elements responsive to the pressure difference across said throttling means, and means for locking said switch in the off position.

9. An electric continuous-flow heater comprising a unitary one-piece base composed of an electrically insulating material having inlet and outlet electrical water column resistance channels therein, said channels opening into an exposed face of said base; a heating element sub-assembly removably mounted on the exposed face of said base comprising a body member having a heating channel therein, means for connecting said heating channel to said resistance channels at the exposed face when said heater is assembled, an electrical heating coil arranged in said heating channel to permit water to circulate in contact with said heating coil, and electrical terminals mounted on said body member and being connected to said heating coil.

10. An electric continuous-flow heater according to claim 9 having elastic sealing rings interposed between the openings of said resistance channels and said heating channel connecting means, one of said sealing rings having its opening constricted to provide a throttling action.

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