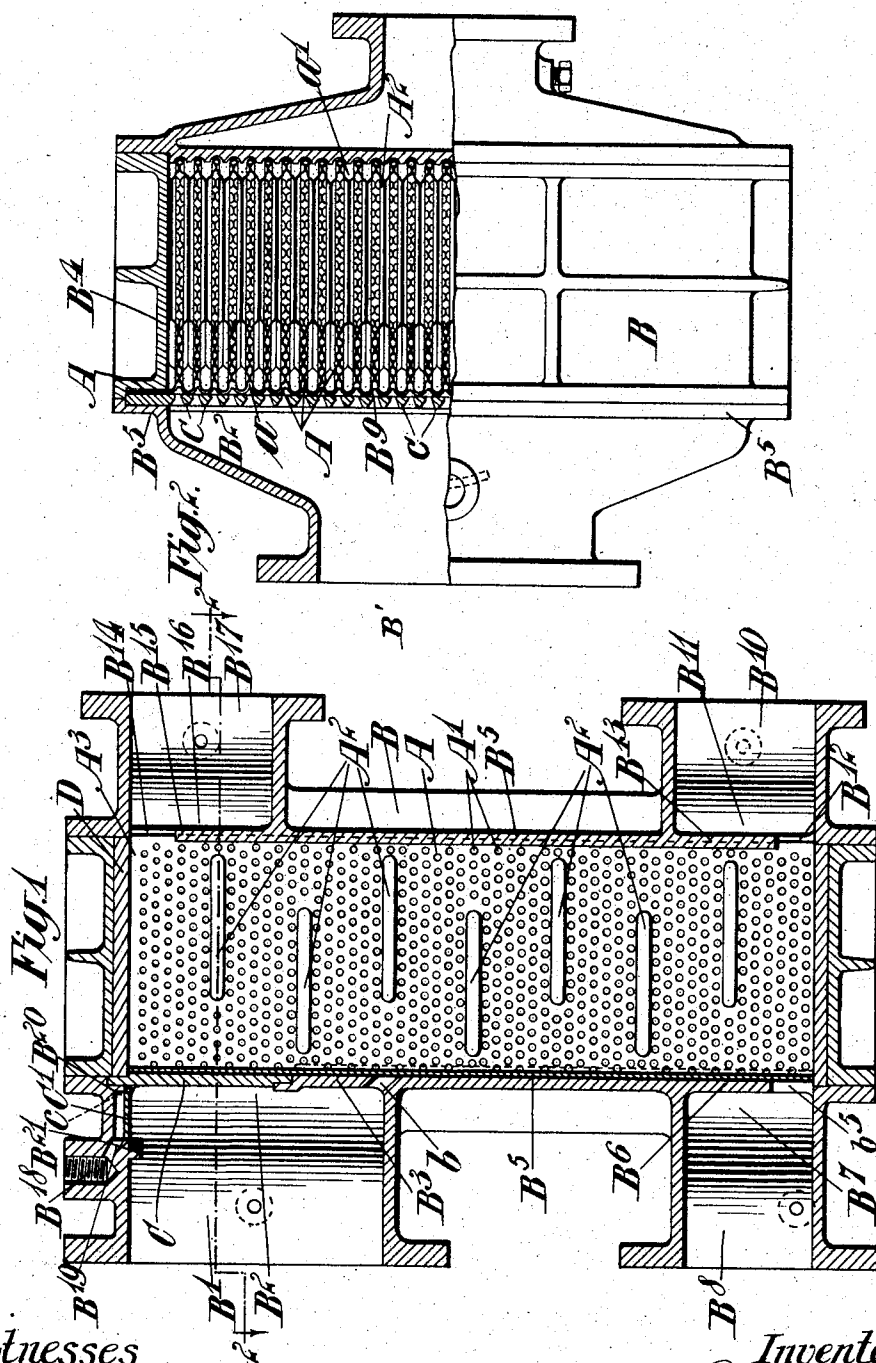


No. 791,876.

PATENTED JUNE 6, 1905.

A. F. BURDH.
CONDENSING APPARATUS.
APPLICATION FILED MAR. 14, 1905.

2 SHEETS—SHEET 1.



Witnesses
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2 SHEETS—SHEET 2.

Fig. 5.

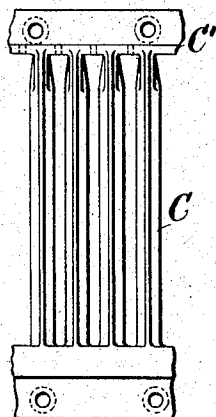


Fig. 4.

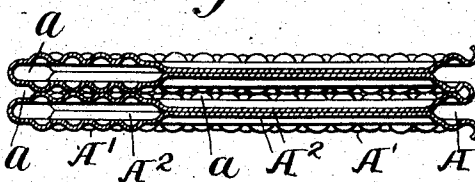
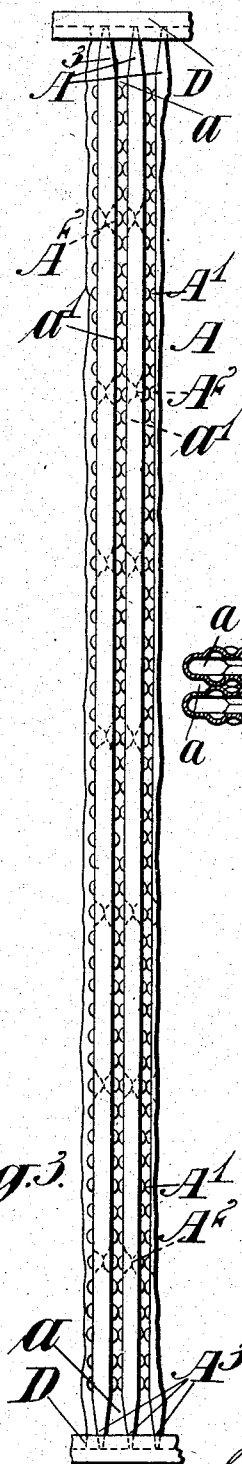


Fig. 3.



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UNITED STATES PATENT OFFICE.

ARCHIBALD FRASER BURDH, OF BALHAM, ENGLAND.

CONDENSING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 791,876, dated June 6, 1905.

Application filed March 14, 1905. Serial No. 250,113.

To all whom it may concern:

Be it known that I, ARCHIBALD FRASER BURDH, a subject of the King of England, residing at Balham, England, have invented certain new and useful Improvements in Heating, Cooling, Condensing, Evaporating, and Similar Apparatus, of which the following is a specification.

This invention relates to cooling, heating, and similar apparatus, and refers chiefly to apparatus in which a sheet or plate of metal is bent or folded or in which single sheets or plates are joined at opposite edges to sheets or plates on either side of them to form passages or chambers for the fluid to be treated alternating with passages or chambers for the medium acting thereon. Either or both surfaces of the sheet are provided with projections, protuberances, or the like; and the chief objects of the invention are to provide for a thorough circulation of the heating or cooling medium through the chambers and also to prevent or tend to prevent injury or undue wear to the parts of the sheet or the projections thereon at the inlet of the chambers, as is liable to take place, especially if steam is being treated. Provision is also made for the circulation through the apparatus of a cleansing charge or solution.

According to my invention a thin plate or sheet of copper, aluminium, or other appropriate metal is bent or folded upon itself, or separate sheets are united as aforesaid, to form shallow passages or chambers, the main walls of the said passages or chambers being formed by the sections of the sheet. On the inside walls of one series of chambers are formed isolated projections or the like of hemispherical or other appropriate form, which are arranged in rows, staggered or otherwise, and on the inside walls of the other series of chambers, which are preferably of larger capacity than those of the first series, are formed elongated projections, ridges, or bars running across the chamber to within a convenient distance of the edges or side walls thereof. These isolated projections on the walls of the chambers may come opposite each other with or without a slight space between them, or they may be so arranged that

they overlap or project beyond each other, and the bars or ridges in the other series of chambers are staggered and arranged so that a bar or ridge of one wall comes against or opposite a correspondingly-placed ridge or bar on the other wall. These projections and ridges may be formed on or attached to the sheet in any appropriate manner, but are preferably integral with the sheet and formed by stamping, punching, or in any other similar manner. The bars or ridges on the same wall of each of the chambers are preferably arranged so that one bar does not come exactly opposite or in line with the neighboring bar, but that a small space exists between one end of the ridge and the adjacent end wall of the chamber and a larger space is formed between the other end of the ridge and the opposite end wall, the next bar being placed so that the large and small spaces between its ends and the said walls come opposite the small and large spaces, respectively, of the neighboring bar. This bent sheet is disposed in a suitable casing, conveniently with the folds running vertically, and the joint between the open ends of the passages or chambers or the sharp edges of the sheet and the casing is made fluid-tight in any appropriate manner, but preferably by running in white-metal. The projections and ridges above referred to serve as distance-pieces, preventing the sheet from bulging or being displaced, and the folds or bends are forced close up against the side walls of the chamber of the casing in which the sheet is arranged, which may be hollowed or otherwise formed to tend to hold the sections in position and prevent rattling. The free edges of the sheet are preferably passed between the flanges of the side plates and covers of the apparatus and secured by the bolts connecting the parts together. In order to protect the sheet at the folds or bends and also the projections at the inlet to either or both series of passages or chambers, there is provided a grating, grid, or a series of bars or ribs of triangular or other appropriate cross-section so disposed that they prevent the incoming fluid from striking directly on the folds or bends and deflect it so as to direct it to the center of each chamber. When, for example, the apparatus is arranged as a

surface condenser, the exhaust-steam is admitted to the series of shallow chambers having the isolated projections above referred to, and the cooling-water flows through the relatively larger passages or chambers in which the elongated projections or ridges are disposed.

In a preferred construction as applied to a condenser the casing consists conveniently of side and end walls and top and bottom covers, within which the sheet, or joined sheets, forming the chambers is or are disposed as above stated. Junction pieces or boxes are provided conveniently at or near the top and bottom of each of the side walls for connection with suitable inlet and outlet pipes to both series of passages or chambers. The steam enters the cooling or more, shallow chambers by an inlet at the top of the apparatus and is distributed equally to the various passages or chambers of the series by a tapering conduit which leads from the junction-piece and extends entirely across the casing of the apparatus. The protecting bars or grid are placed between the delivery end of this conduit and the inlet to the cooling passages or chambers. The inlet-pipe is generally larger than is desirable, and in order to direct the steam to the upper end of the chamber a baffle-plate or stop is placed in the lower part of the inlet-conduit. This baffle forms a support for one end of the grid, which is riveted or otherwise secured to it. The grid thus occupies the upper part of the delivery end of the conduit and is therefore disposed in the inlet proper. It is provided at its upper end with a flange extending at right angles to the grid itself and also with another flange which extends between the flanges of the side cover and end plate to which it is screwed, riveted, or otherwise secured. Any condensed steam or water carried over with the steam is thrown down by the baffle and permitted to drain through openings at the lower edge thereof into the chambers. A similar stop or baffle-plate is provided at the outlet for the condensed steam, which is collected from the condensing passages or chambers by a tapered conduit similar to that above referred to. The cooling-water enters at the lower end of the casing on the other side of the sheet and escapes at the top after passing through the passages or chambers, and in order to increase the circulation baffle-plates or stops are provided in the inlet and outlet conduits, so that the water enters and leaves by openings of much smaller area than the supply and delivery pipes. In order that the steam on entering may be distributed equally, the walls at the top of the steam passages or chambers are bent outwardly, so that each passage or chamber is somewhat V-shaped at the upper or inlet part, and preferably the projections on the sheet are omitted at this part. The steam in passing through the condensing passages or

chambers is broken up into small streams and impeded in its passage, causing a thorough mixing or agitation and bringing fresh portions continuously into contact with the walls of the chambers on the opposite side of which the cooling-water is passing. A thorough mixing, agitation, or churning of the cooling-water is insured by the currents set-up by the ridges and the manner in which they are disposed in the chambers, so that fresh portions of cooling-water are being constantly brought into contact with the walls when the apparatus is in operation. A cleansing charge of soda or other solution is delivered to the upper ends of the steam passages or chambers when desired, the conduit being controlled by a cock or the like. The supply-conduit opens into the steam-inlet conduit, and the solution enters the steam passages or chambers formed by the folded sheet through small openings which are protected by a semicircular or other baffle.

Although the apparatus has been described as applied to the condensation of steam, it is to be understood that it is not intended to limit the invention to this or other specific purpose, as the apparatus can be used for other purposes without departing from the spirit of the invention, nor is it intended to limit the invention to the particular details of construction above referred to, as these may be greatly modified in accordance with the requirements.

Referring to the drawings, Figure 1 is a vertical section through an apparatus adapted for condensing exhaust-steam constructed in accordance with the present invention. Fig. 2 is a plan, partly in section, on the line 2 2 of Fig. 1. Fig. 3 is a side elevation of a part of the sheet by which the condensing-passages are formed, on an enlarged scale. Fig. 4 is a horizontal sectional view on substantially the same scale as Fig. 3. Fig. 5 is a front elevation of part of the grid.

Like letters indicate like parts throughout the drawings.

A is the sheet, which forms the passages or chambers within the casing B.

C is the grid or protector for the sheet at the steam-inlet.

The sheet A, which is bent or folded in opposite directions alternately, as shown at Fig. 2, is provided on one surface with nodules A' approximately semispherical in form, and these nodules when the sheet is bent project into one series of passages or chambers a , while on the other surface the sheet is provided with elongated projections or ridges A², which extend into the other series of passages or chambers a' . The sheet may be made of copper, aluminium, or other suitable metal, the nodules A' and ridges A² being conveniently struck up by any suitable process from the body of the sheet itself. When the apparatus is used for condensing exhaust-steam, the projections A' preferably extend into the

chambers to which the steam has admission, while the ridges A^2 extend into the chambers through which the cooling-water circulates. Preferably the nodules A' are arranged in staggered rows and so placed that the projections on one wall of the chamber come opposite to and are in contact with the nodules on the opposite wall. They may, however, be otherwise arranged. The ridges A^2 do not extend entirely across the chamber, but, as shown in Fig. 1, are preferably so placed that a small space exists between the ridge and one end wall of the chamber and a larger space is left between the opposite end wall of the chamber and the other end of the ridge. All the ridges on the same wall of the chamber are not arranged in alinement, but are preferably staggered, as shown in Fig. 1, so that larger spaces between the ends of the ridges and the end walls of the chambers are at opposite ends of the ridges alternately. The ridges on one wall of the chamber are preferably in contact with and similarly placed to the ridges on the opposite wall. The exhaust-steam enters by an opening B' , which is in communication with a conduit B^2 , extending across the casing in which the folded sheet is arranged and preferably enlarged adjacent said casing or made tapering, so as to tend to distribute the steam equally to all the chambers a . In order to prevent the steam from striking directly on the bent or folded parts of the sheet, there is mounted in the inlet a grid C or a series of bars, preferably of the shape shown, and this grid rests on a partition B^3 in the conduit B^2 and may be secured thereto by screws or in other appropriate manner. The ends of the grid are secured between the end covers B^4 and the side plates B^5 of the casing. The steam passes from the upper part of the conduit and through the grid into the chambers a , and any steam that may be condensed by impinging on the grid C or the baffle B^3 passes by one or more openings b into the chambers. In order that the steam may have free entry into each of the chambers a , the upper edges A^3 of the sheet A are bent outward from the chambers a or the folds in the sheet are contracted at their upper ends, so as to enlarge the upper ends of the chambers. The condensed steam passes from the lower end of the chambers by an opening b^5 in a baffle B^6 . The condensed steam or water of condensation then enters a conduit B^7 , which extends along the apparatus in a similar manner to the conduit B^2 and has a discharge outlet or opening B^8 , through which the water of condensation can be drawn off to a storage-tank. The lower ends of the chambers a may be enlarged in a similar manner to the upper edges, as shown in Fig. 3.

The cooling-water enters the apparatus through an opening B^{10} and is distributed by a conduit B^{11} , which preferably tapers toward each side of the apparatus, so as to equally dis-

tribute the water to all of the passages a' . The water then enters the chambers a' by an opening B^{12} in a plate B^{13} , situated in the conduit B^{11} , and is caused by the ridges A^2 to be broken up into cross-currents, setting up a churning action within the chambers. The water on coming against the lowermost ridges A^2 on the opposite walls of each chamber will be divided into two currents, a large portion of the water passing between the ends of the ridges at one side of the chamber and a smaller portion at the other. These two currents will meet between the first and second ridges and again be broken up, a small portion passing between the ends of the ridges at that side of the chamber where the large portion passed in the former instance, the larger portion of the water passing between the ends of the ridges and the casing at the same side as the small portion previously passed, and so on with the remaining ridges, such turning or agitation of the water bringing fresh portions constantly into contact with the side walls of the passages or chambers, and the water finally passes from the upper ends of the chambers a' by the opening B^{14} in the plate B^{15} , situated between the conduit B^{16} and the chambers. This conduit extends across the apparatus in a similar manner to the other inlet and outlet conduits and the water is withdrawn from the apparatus by an opening B^{17} .

A fluid-tight joint is made at the upper ends of the chambers by pouring in a mass of lead or other appropriate metal in a molten condition or the ends of the sheet may be embedded in a mass of metal before being inserted into the casing.

The projections A' and ridges A^2 serve as distance-pieces between the sections of the sheet, preventing it from bulging or being displaced, and the folds or bent portions at each end of the chambers a and a' are forced close up against the side walls B^5 of the casing and sufficiently tight to prevent any dangerous or undesirable leakage of the steam from one chamber to another. In addition to this the side walls B^5 may be provided with grooves B^9 , as shown in Fig. 2, these grooves being sufficiently wide to receive the folds and keep them steady. In the drawings the grooves are shown somewhat larger than they will be in practice, but they are so made in the drawings for the sake of clearness. It is to be noted that all the nodules A' are not shown in position on the sheet in Figs. 2 and 3, the alternate rows being omitted to avoid confusion. In the enlarged view shown in Fig. 4, however, these nodules are all shown to correspond with Fig. 1.

The chambers a' , into which the cooling-water is admitted, may be of larger capacity or wider than the chambers a through which the steam is circulated.

A charge of soda or other cleansing solution may be admitted to the steam-chambers,

and this is conveniently supplied to the steam-inlet conduit B^2 through an opening B^{18} , communicating with a conduit B^{19} , which terminates in a chamber B^{20} . This chamber is conveniently formed by a recess in the walls of the casing B and a flange C' on the grid C . A convenient number of openings c (shown in dotted lines in Fig. 1) are formed in the flange C' , and a protecting-baffle B^{21} is provided in front of the openings to prevent the steam blowing back into the soda-conduit.

The apparatus has been described as applied to the condensation of exhaust-steam, but, as above stated, it is not intended to limit it to this particular purpose, as it may be employed for heating, evaporating, oil-purifying, and other purposes.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In apparatus for heating, cooling, condensing, evaporating and similar purposes the combination with a casing, and a metal sheet extending entirely across a chamber in said casing, and bent or folded upon itself in opposite directions alternately to form within said chamber two independent series of passages, of nodules formed on the walls of one of said series of passages and ridges, such as A^2 , formed on the walls of the other series of passages, substantially as described.

2. In apparatus for heating, cooling, condensing, evaporating and similar purposes the combination with a casing having therein a chamber provided with channels or grooves in opposite walls, and a metal sheet extending from one end of said chamber to the other and bent or folded upon itself in opposite directions alternately the edges of said sheet extending into the aforesaid channels in the walls of the chamber whereby said sheet forms within the chamber two independent series of passages, of nodules formed on the sheet and extending into one series of passages and ridges, such as A^2 , formed on the sheet and extending into the other series of passages, substantially as described.

3. In apparatus for heating, cooling, condensing, evaporating and similar purposes the combination with a casing, of a metal sheet, having thereon nodules A' and ridges such as A^2 , bent or folded to form within said casing two independent series of passages and having the folds therein contracted adjacent the upper or inlet end of one of said series of passages, substantially as and for the purpose described.

4. In apparatus for heating, cooling, condensing, evaporating and similar purposes the

combination with a casing having therein two independent series of passages, of nodules A' formed on the walls of one series of passages and ridges such as A^2 formed on the walls of the other series of passages, substantially as described.

5. In apparatus for heating, cooling, condensing, evaporating and similar purposes, the combination with a casing, of a metal sheet bent or folded upon itself in opposite directions alternately and forming within the casing two independent series of passages, said sheet having on parts forming the walls of one series of passages nodules and on the parts forming the walls of the other series of passages ridges arranged in staggered rows, substantially as described.

6. In apparatus for heating, cooling, condensing, evaporating and similar purposes, the combination with a casing and a metal sheet bent or folded upon itself in opposite directions alternately to form within a chamber the casing two independent series of passages each having a separate inlet and outlet opening, of bent portions on the sheet at the upper or inlet end of one series of passages, nodules on the sheet extending into one series of passages, ridges such as A^2 on the sheet extending into the other series of passages and a grid at the inlet to one series of passages, substantially as described.

7. In apparatus for heating, cooling, condensing, evaporating and similar purposes, the combination with a casing having therein two independent series of passages, of nodules A' formed on the walls of one series of passages, and ridges A^2 formed on the walls of the other series of passages and arranged in staggered rows, substantially as set forth.

8. In apparatus for heating, cooling, condensing, evaporating and similar purposes, the combination with a casing, of a metal sheet extending entirely across a chamber within the casing and bent or folded upon itself in opposite directions alternately to form within said chamber two independent series of passages, the folds or bends in said sheet being contracted to increase the width of the passages of one series adjacent an inlet in the casing, substantially as and for the purpose described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ARCHIBALD FRASER BURDH.

Witnesses:

H. D. JAMESON,

C. P. LIDDON.