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FILLING BLOCK FOR HEAT EXCHANGE, REACTION, AND ABSORPTION APPARATUS

Fig. 5

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2 Sheets-Sheet 2

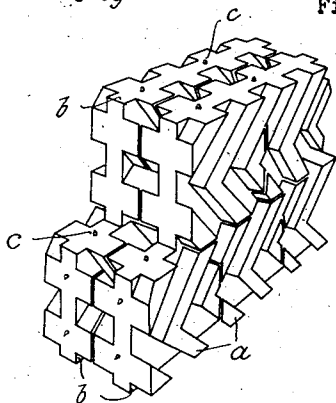


Fig. 7.

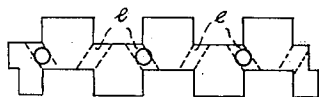
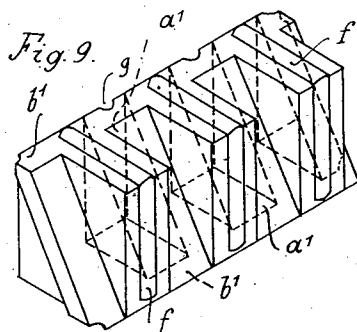


Fig. 9a.

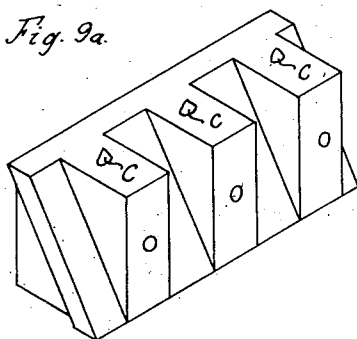
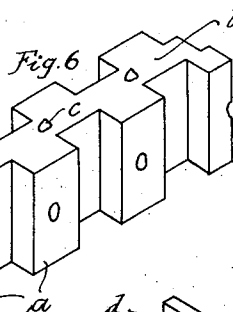


Fig. 6

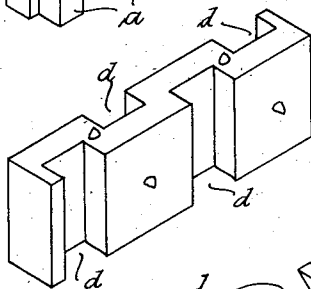


Fig. 8.

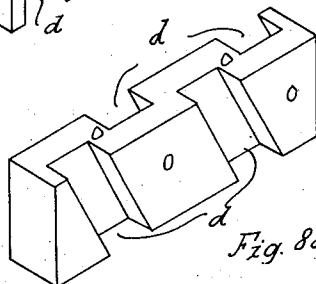
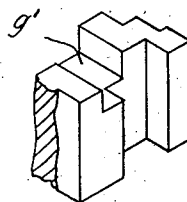


Fig. 8a.

Fig. 10.



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FILLING BLOCK FOR HEAT EXCHANGE, REACTION, AND ABSORPTION APPARATUS

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This invention refers broadly to filling and packing bodies to be employed for the filling of heat exchange apparatus, such as for instance the so-called Cowper apparatus, reaction, absorption and similar kinds of towers and spaces adapted for the production of mutual reactions of gases and liquids, and broadly considered for all purposes in which a physical or a chemical action is to be produced on large masses of gaseous and liquid agents, and it is intended among other important objects to devise means of obtaining a more uniform convection of the heat and a more thorough reaction than usually obtainable heretofore, and to facilitate the manipulation and to produce a very stable accumulation of such bodies in the particular space without any danger of undue retaining and accumulation of flue-dust and other impurities. In accordance with the previous art the packing of the spaces of the kind referred to either comprised an irregular accumulation of different regularly or irregularly shaped packing bodies which were merely dumped into the particular space and the action of which was mainly based upon the immense increase of surface produced thereby; or such packing consisted of brick-like bodies which were arranged in a checker-like manner in the reaction space or the like. With the kind of packing first mentioned there was the difficulty that the draft was considerably interfered with, while with the brick-like or checker-like arrangement the contact of the gaseous and liquid agents was not sufficiently intense, and the convection of heat was not uniform, inasmuch as the different cross-sectional parts of the streams of the gases possessed different velocities and were partly retained by friction and adhesion at the walls of the filling bodies. On the other hand there was the difficulty that, if a more uniform stream of gases was intended to be produced by a denser packing of such bricks there was a danger of interfering with the draft and the deposition of flue-dust in the channels produced. Nor could the difficulties referred to be avoided by the provision of alternate enlargements and constrictions of the channels, as suggested in the previous

art, inasmuch as with this arrangement the accumulation of flue-dust was even increased and the manipulation of such bricks and the packing of the spaces was rendered very difficult. There was the additional objection with the previous suggestions of bodies of the kind referred to that the flow of the gases and the exchange of heat was retarded and checking up of the channels was liable to occur, and moreover difficulties arose from the increase of friction of the gases and reagents on the surfaces of the packing and the frequent change of the direction of flow.

My invention which is based on the principle of brick-like packing bodies is intended to avoid these difficulties by providing for a series of continuous vertical or inclined channels of substantially equal diameter and parallel to each other or divided into parallel groups of channels, these channels being mainly produced by corresponding grooves or recesses or ribs running along opposite surfaces of the particular brick. By this means a block is produced which is mainly composed of a plurality of elements constituting geometrical figures of equal shape and sizes, so that the bricks and composite blocks obtained by the union of these elements can be easily handled and mounted promiscuously in any particular position and in any section of the space to be packed.

The invention is shown by way of example in different embodiments of the accompanying drawings, without, however, being restricted to the particular shape and arrangement illustrated. In the drawings Fig. 1 shows a packing or filling body according to this invention with inclined, substantially oppositely disposed parallel grooves or ribs.—Fig. 2 shows by way of exemplification a kind of packing obtained with this kind of bricks or blocks according to Fig. 1 of the drawings.—Fig. 3 is a diagrammatic representation of the path of the gases within the channels produced for instance in the embodiment of Fig. 2 of the drawings.—Fig. 4 shows another kind of packing by means of the filling bodies with inclined ribs or grooves with the provision, however, that the bodies are turned through 90 degrees in the

superimposed layers.—Fig. 5 is a modified construction showing the provision of projections or the like for the purpose of facilitating the union of the different bricks.—Fig. 6 is another modification illustrating alternatingly disposed straight ribs on opposite sides of the brick.—Fig. 7 is a plan view of a brick according to this invention and illustrating as an exemplification the provision of communicating transverse holes or perforations.—Fig. 8 and Fig. 8a are perspective views of other modifications in which instead of ribs the brick comprises a plurality of parallel, zigzag-like grooves and rectangular projecting portions, Fig. 8 showing the grooves and projections running in the straight longitudinal direction, while Fig. 8a is a modified construction with the grooves and projecting portions constituting inclined recesses. In Figs. 9 and 9a I have shown a modified construction in which the grooves, ribs or recesses, instead of being provided at the sides of the brick, are arranged on the upper and lower surfaces thereof, so as to be axially turned through an angle of 90 degrees with relation to the bricks shown in the other embodiments the intermediate longitudinally extending, plate like web being transversely inclined.—Fig. 10 is a representation of another form of construction in which a part of the rib and of the adjoining web is cut away so as to admit of communication between the channels on the opposite sides of the brick in a manner similar to the purpose of the modification shown in Fig. 7 of the drawings.

The ribs *a* or rib-like projecting portions, as appears from the drawings may be arranged either opposite each other or they may be alternatingly arranged on opposite sides of the brick. With the arrangement of ribs *a* a web-like central portion *b* is formed which, on account of the increased radiation will readily absorb and radiate the heat to the channels produced by the ribs or recessed portions. The ribs may extend across the broadest sides of the brick-like parallelopipedic body and both in parallel relation to the edges thereof as in an inclined direction, and the arrangement may be such that, while the general direction of the bricks is retained, they are arranged in the successive superimposed layers with their ribs extending at different inclinations so that zigzag-like channels are produced, as appears particularly from Figs. 2 and 3 of the drawings. I may also combine the bricks with the inclined ribs with layers of bricks in which the ribs extend substantially in parallelism with the sides. This latter arrangement has been found particularly advantageous at the top and bottom of the reaction or heat-exchange chambers. Generally speaking the bricks with inclined transverse ribs or projecting parts have been found to be

more satisfactory than the bricks with straight ribs which extend in parallelism with the short sides of the bricks, but for some purposes the latter kind of bricks has also proved to be of great service. With the inclined arrangement the gases and other reagents will flow substantially as pointed out in Fig. 3 of the drawings from which it appears that at the points of change of direction of flow the gases and reagents will strike against the sides of the ribs and are by this means most vigorously agitated and mixed. This action is further assisted by the fact that, as above pointed out, the gas current does not possess the same velocity in all its sectional parts, inasmuch as the lateral parts of the stream will lag behind somewhat with relation to the other portions, particularly the central parts of the gas stream, this action being indicated in Fig. 3 of the drawings by the dotted lines. In the case of the use of liquids in combination with gaseous reagents the liquids are highly disintegrated and atomized by the inclined ribs and the frequent change of direction of flow and are thereby caused to intimately react with each other. The corners produced by the change of direction of the ribs on one and the same side of the brick-body may also be rounded off, so that the ribs will present a substantially serpentine configuration. Also in the case of straight ribs a very high degree of efficiency is produced, inasmuch as in view of the very increased action of the draft the lateral otherwise slowly moving parts of the gas streams will be strongly aspirated and thereby thoroughly mixed with the expanding central portions of the stream. This mixing action may be further assisted by arranging the bricks in the different superimposed layers at different angles, so as to obtain the usual check-like arrangement of bricks, and it is obvious that this arrangement may be used equally well with the straight and with inclined ribs.

In the modification of Figs. 8 and 8a there is no web portion properly speaking, but the ribs are produced by causing alternate sections of the brick to project outwards in different directions or by bending the brick so to speak, so as to present a succession of adjacently disposed recesses *d* and intervening projecting parts. In the modification of Figs. 9 and 9a of the drawings the ribs are designated *a1* and the web portion *b1*, and in this arrangement in which the grooves run cross-wise of the upper and lower surfaces instead of running crosswise of the sides as in the other modification a zigzag configuration of the grooves and ribs may also be obtained. By the combination of this kind of bricks with the bricks of the other modifications and with ordinary bricks a variety of different forms and arrangements of channels may be obtained.

In order to facilitate manipulation of the bricks and assist the operator in arranging them in groups of blocks the bricks may be provided with interengaging projections and sockets or grooves, as shown for instance in Figs. 5, 6, 8 and 9 and 9a of the drawing. For this purpose I may either provide buttons or conical studs *c* on the contacting surfaces of fins *f* and grooves *g* as interengaging connecting members, so that a plurality of properly arranged bricks of blocks according to my invention, when provided with the projections mentioned may be handled as one compact unit, so as to greatly facilitate the packing of the various spaces with the bricks according to my invention. A plurality of such bricks, properly arranged and combined constitutes a packing block provided with a plurality of continuous parallel channels or groups of channels running in the axial or inclined direction. Inasmuch as the component bricks of such composite blocks are not likely to become displaced in handling, the operator, when packing a tower or the like, can arrange the bricks outside of the particular space and then insert a plurality thereof at a time.

The exchange of heat and of reagents may be further increased by the provision of holes or the like *e*, as shown in Figure 7, and which pass from one side to the other of the bricks. They are here shown as running at an inclination to the general direction of the bricks, but should be understood that they may extend at right angle to the longitudinal direction of the bricks. According to another modification indicated particularly in Figure 10 of the drawings a groove or cross-sectionally angular aperture *g'* is provided on the upper or lower surface of the brick and transversely thereof, so as to establish communication between the channels on the opposite sides. This is of importance both for the better exchange of heat and of reagents, as well as a means to keep up the draft and the communication through the packing even in case one or the other of the channels should have become choked up.

In the modification according to Figures 9 and 9a of the drawings the ribs instead of presenting substantially rectangular or rhombic parallelogram shape as in the other exemplifications are of substantially triangular shape in transverse section. These flat triangular ribs *a'* are secured in parallel spaced relation to each other on an inclined base *b'*, so that in this modification the inclination is produced by the base, instead of by the lateral inclination of the parallel projecting rectangular ribs. This modification may be obtained from an ordinary brick or block by providing the upper and lower surfaces, that is to say the top and the base of the brick, instead of the sides thereof, with spacedly disposed parallel groove or recesses

which may run both at an inclination to said surfaces, as well as parallel thereof. In the latter case the ribs will of course, be of rectangular, parallelogram shape. In Figure 9 the ribs are indicated at *a'* and the web at *b'*.

In all the various modifications a uniform exchange of heat and of reagents is obtained, and a broad, stable supporting surface is provided for the different layers of bricks or blocks. The bricks may be arranged in any suitable manner in the different layers, and the layers themselves may either have the bricks running in the same direction in all of the layers or crossing each other in the different layers or in each layer or in some of them groups of bricks may be arranged so as to run in different directions with the constituent bricks of each group parallel to each other. The bricks according to my invention may also be combined with heat-exchange should be understood that the invention both as regards the construction of the bricks, as well as the arrangement of them in a packing space is susceptible of other modifications and changes within the purview of the claims hereunto appended.

Preferably the dimensions of the packing should be such that the cross sections of the channels between the ribs amount to at least half of the cross section of the center portion, and the total free area of the channels amounts to about one third of the cross sectional area of the space to be packed.

I claim:—

1. Packing for heat-exchange and other purposes, comprising substantially brick-shaped bodies, spaced parallel projecting ribs on opposite surfaces thereof, and substantially small projections and sockets on the outside of the adjacent brick-shaped bodies.

2. Packing for heat exchange and other purposes, comprising a plurality of substantially brick-shaped bodies, spaced parallel projecting ribs on opposite surfaces thereof, and substantially small projections and corresponding sockets on the outside of the adjacent bricks and of the projecting ribs thereof.

3. Packing body for heat-exchange and other purposes, comprising a brick-like body, and spaced parallel inclined grooved portions on opposite sides thereof, and comparatively small complemental projections and sockets on the parts between the grooved portions adapted to facilitate engagement of said body.

4. Packing body for heat exchange and other purposes, comprising a solid, brick-like body of substantially quadrangular cross-section, a plurality of spacedly parallel, outwardly and laterally flat projecting ribs, disposed upon and extending across the two opposite, broadest longitudinal sides of the body, and of equal height, said ribs and the body being inclined with relation to each other.

5. Packing body for heat exchange and

other purposes, comprising a solid, brick-like, parallelopipedic body of substantially quadrangular cross-section, a plurality of equally spaced, equally projecting, parallel, outwardly and laterally flat, cross-wise quadrangular
5 ribs, disposed and extending across the two opposite, broadest and parallel sides of the body, and forming acute angles with certain surfaces of said body.

10 6. Packing body for heat-exchange and other purposes, comprising a substantially plate-shaped, brick-like body, alternately disposed projecting portions on the opposite broad sides of said body and respectively projecting and correspondingly depressed engag-
15 ing and guiding means on the outside of said body and of comparatively small size.

20 7. Packing body for heat exchange and other purposes, comprising a flat, substantially plate-shaped sectionally quadrangular web-portion of parallelogram-like cross section, and a plurality of parallel, equidistant, parallelopipedic ribs of equal thickness and width along the opposite broad surfaces of
25 said web portion, and at distances substantially equal to their width, the thickness of said ribs being substantially equal to that of the web portion.

30 8. Packing body for heat exchange and other purposes, comprising a solid, endwise flattened, brick-like body of substantially quadrangular cross-section, a plurality of spacedly parallel, outwardly and laterally flattened projecting ribs, disposed upon and
35 extending across the two opposite, broadest longitudinal sides of the body and of equal height.

In testimony whereof I have hereunto set my hand.

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HUGO WILISCH.

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