United States Patent [19]

Carlson

[11] **3,750,887**

[45] **Aug. 7, 1973**

[54] **FILTER MEDIA FOR LIQUID WASTES TREATMENT AND METHOD OF FORMING THE SAME**

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[22] Filed: **Sept. 15, 1971**

[21] Appl. No.: **180,549**

[52] **U.S. Cl.** **210/150**

[51] **Int. Cl.** **B01d 39/14**

[58] **Field of Search** 210/150, 151, 293

[56] **References Cited**

UNITED STATES PATENTS

3,452,871	7/1969	Hoover et al.	210/150
3,496,101	2/1970	Hay	210/150 X

FOREIGN PATENTS OR APPLICATIONS

562,087	6/1944	Great Britain	210/293

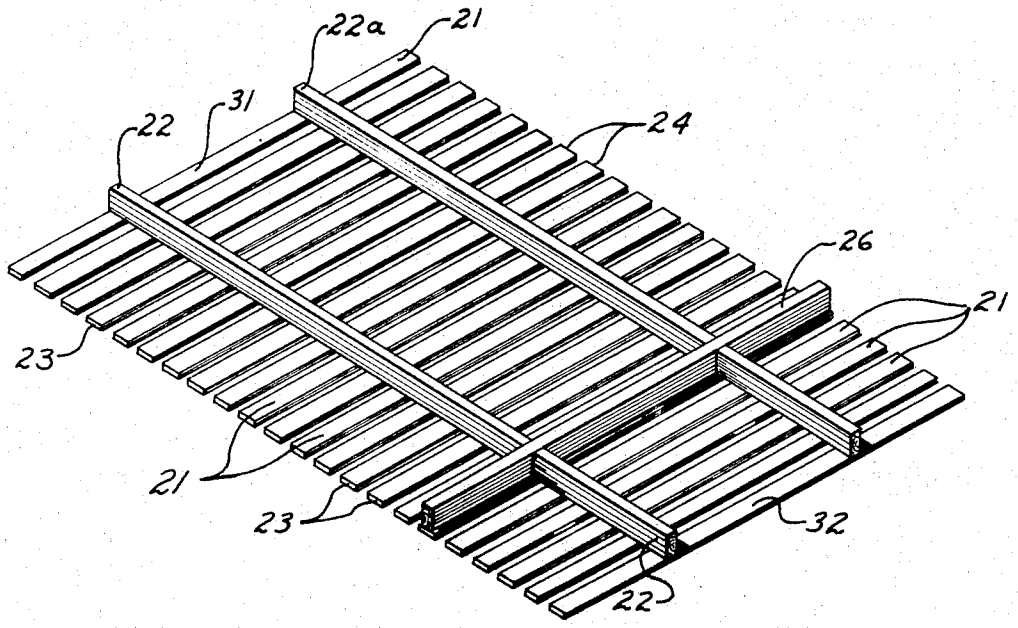
Primary Examiner—John Adee

Attorney—Manfred M. Warren et al.

[57] **ABSTRACT**

A pallet-like unit for use with a plurality of similarly formed units in the formation of a biological filter media for the treatment of liquid waste and the array of such units is disclosed. The unit includes a plurality of elongated growth supporting surfaces, preferably redwood laths, which are secured to supporting members positioned inwardly of the periphery of the unit and preferably in mutually perpendicular relation to form a self supporting stackable structure. The positioning of the supporting members enables stacking of the units in vertically superimposed horizontally extending layers with selected layers being horizontally staggered or displaced so that units overlap each other to even out dimensional variances and provide greater stability in the filter array.

8 Claims, 5 Drawing Figures



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3,750,887

SHEET 1 OF 2

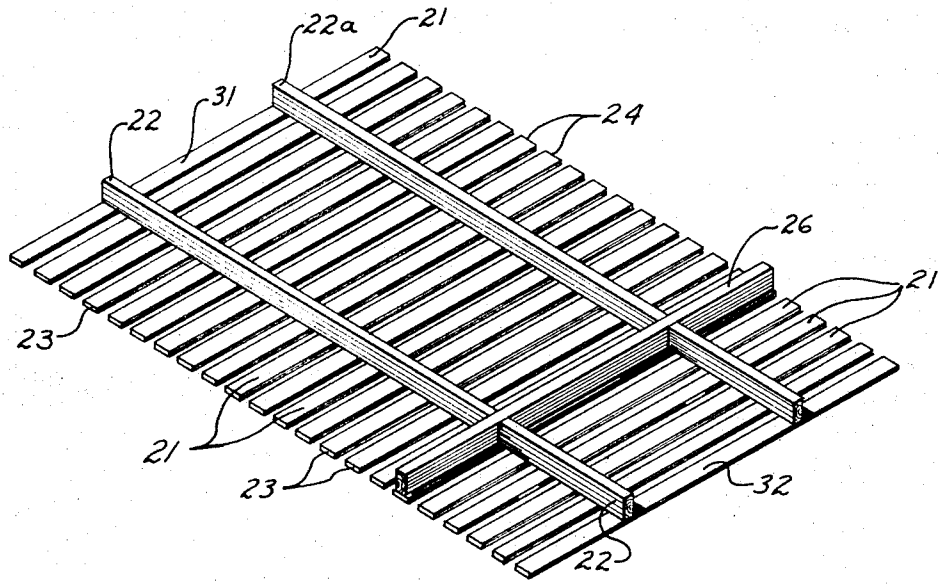


Fig. 1.

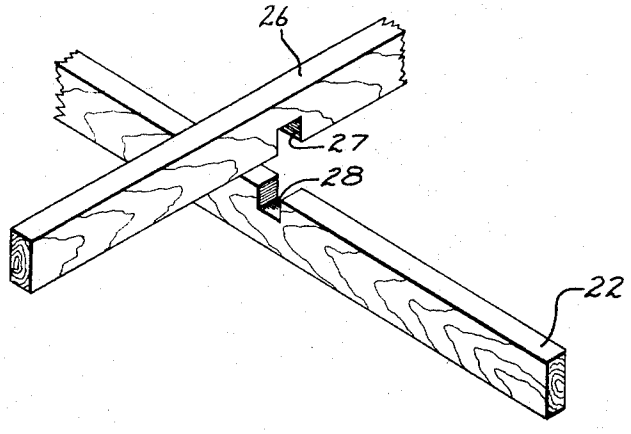


Fig. 2.

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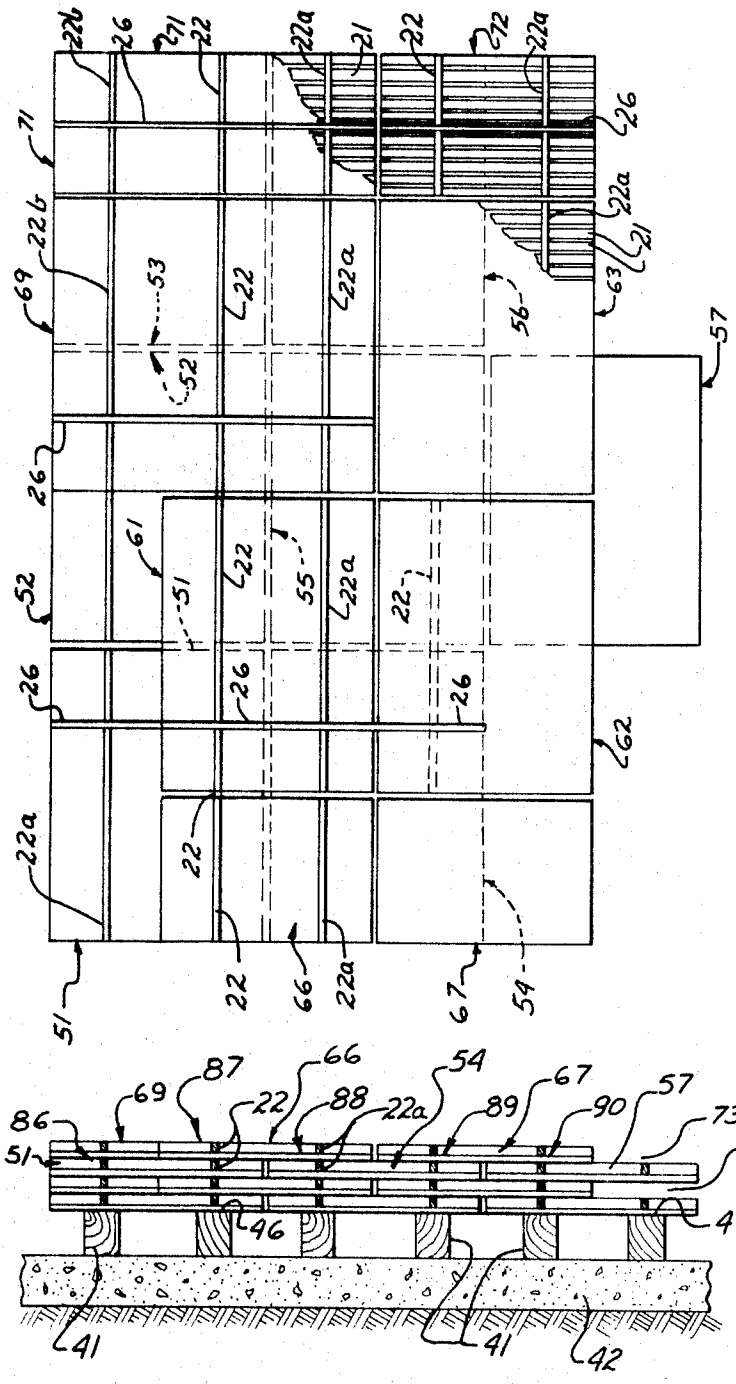


Fig 4.

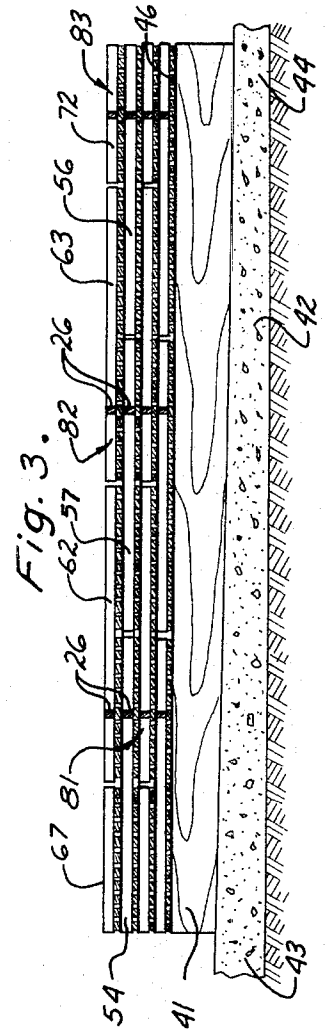


Fig. 3.

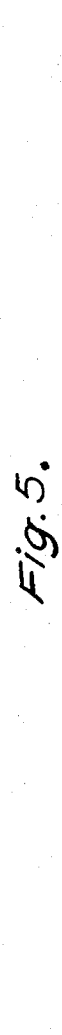


Fig. 5.

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FILTER MEDIA FOR LIQUID WASTES TREATMENT AND METHOD OF FORMING THE SAME

BACKGROUND OF THE INVENTION

The treatment of liquid wastes by means of pallet-like units has been found to be highly advantageous. These units are preferably constructed of a plurality of wood or plastic laths or slats which are secured to underlying supporting members to provide a self-supporting unit. These units can be stacked to virtually any desired height to form a grid-like filter array. The pallet-like units which have been previously used have been constructed in the same manner as is set forth in detail in the U.S. Pat. Nos. 3,496,101 and 3,452,871. In these units, the plurality of redwood lath members are secured at their ends to underlying runners or support members. Additionally, an intermediate supporting member was preferably provided in order to increase the strength and stability of the unit.

In use, the pallet-like units previously employed have been stacked with one unit superimposed in alignment above the next over the entire vertical height of the filter array. The stacks of units were placed side-by-side to get the desired plan area of the array, and in some instances adjacent stacks of units were tied together by a variety of techniques, including the use of wires, retaining walls or lumber.

The construction of liquid waste treatment filter arrays in accordance with the above described prior practices has been found to have certain disadvantages. As was above noted, the stacking of units often required an auxiliary structure to tie the adjacent stacks of units together and provide stability therefore. Still further, the pallet-like units are preferably formed from rough-redwood having substantial dimensional variance. Accordingly, stacks of an equal number of units often resulted in differences in the overall heights of the stacks. Thus, some attempt to even-out the cumulative dimensional differences between adjacent stacks was usually required.

Accordingly, it is an object of the present invention to provide a pallet-like unit for the construction of a biological filter for the treatment of liquid wastes which has improved strength and stability.

It is another object of the invention to provide a biological filter media array which eliminates the need for auxiliary stablizing structures while remaining easy and economical to construct and install.

It is another object of the presentinvention to provide a biological filter media array in which dimensional variations in the individual units in the array tend to be cancelled.

SUMMARY OF THE INVENTION

Briefly, the pallet-like unit for use in the formation of a biological filter media of the present invention is comprised of a plurality of biological growth supporting surfaces positioned in substantially parallel and relatively spaced relation on a supporting structure including a first supporting member positioned and extending transverse to the longitudinal axes of said surfaces and in superimposed relation to the surfaces. The supporting structure further includes a second supporting member mounted to extend transverse to and intersect the first supporting member, and both supporting members are positioned intermediately of opposed

sides of the periphery of said unit. The supporting members are additionally preferably positioned with respect to the supporting surfaces, preferably laths, so as to allow positioning of the units in overlapping relation with the supporting structures of the overlapped units in vertical alignment. A filter media array formed with the pallet-like units constructed in accordance with the present invention may employ overlapping units to stabilize the entire array and utilizes the mutually perpendicular supporting members in individual units to give support against shear forces in two directions to further enhance the improved stability of the array achieved by overlapping units. Additionally, overlapping of units results in an evening out of dimensional variation in individual units.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top perspective view of a pallet-like unit constructed in accordance with the present invention.

FIG. **2** is an enlarged fragmentary view of supporting members used to form the unit of FIG. **1**.

FIG. **3** is a top plan view of a biological filter media array constructed in accordance with the present invention.

FIG. **4** is an end elevational view of the array of FIG. **3**.

FIG. **5** is a side elevational view of the array of FIG. **3**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1** and **2**, the pallet-like unit for use in the formation of a biological filter media array of the present invention can be seen to be comprised of a plurality of elongated generally horizontally extending biological growth supporting surfaces **21**, which are preferably formed as individual lath members or slats. Surfaces or laths **21** are positioned in substantially parallel and relatively spaced apart relation over the lengths thereof to provide a gird work. In order to support the grid work of biological growth supporting surfaces, it is a feature of the present invention to provide a supporting structure which includes a first supporting member **22** extending transverse to the longitudinal axes of the surfaces **21** and positioned in relative superimposed relation to the surfaces to intersect all of the surfaces comprising the unit. Surfaces **21** are secured to support member **22**, preferably adjacent the intersection with the support member, by fasteners such as nails or staples or by adhesives, and supporting member **22** is positioned intermediately of opposite ends **23** and **24** of lath **21**. A second supporting member **26** is mounted to extend transverse to and intersect supporting member **22** and is further secured to supporting member **22**, such as is shown in FIG. **2** by means of mating notches **27** and **28** and suitable adhesive or a fastener. Second supporting member **26** is further positioned in superimposed relation to said surfaces intermediately of the outer most of said surfaces, namely, surfaces **31** and **32**. The unit as illustrated in FIG. **1** is further preferably formed with an additional first supporting member **22*a*** to which laths **21** may be secured. Additional first supporting member **22*a*** is positioned in generally parallel relation to first supporting member **22** and provides an overall filter media unit which has very substantial strength and stability.

Thus, instead of positioning first supporting members **22** and **22a** at ends **24** and **23** of laths **21** and further positioning second supporting member **26** down the middle of the laths, parallel to the other two supporting members, as was done in the prior art, the supporting structure of the present invention is formed by having a first supporting member, with both members positioned inside the periphery of the unit in superimposed relation with the laths. As shown in FIG. **1**, the laths are beneath the supporting structure. When an array made of a plurality of units is formed, the units can be stacked with the supporting structure either superimposed beneath or on top of the laths while still maintaining the advantages of the present invention.

The laths **21** and supporting members **22** and **26** may be formed of various materials. Thus, redwood or pressure treated wood can be used, as can plastic, with appropriate fasteners or adhesives. It should be noted further that the biological growth supporting surfaces could be integrally formed as one member, instead of a plurality of laths. Thus, if formed from a plastic material, such as by injection molding, the grid work of surfaces **31** might be integrally formed with and connected by the supporting members **22** and **26.**

It is an important feature of the present invention that the pallet-like unit illustrated in FIG. **1** is formed in a manner which greatly increases its stability, as will be explained in more detail hereinafter, without increasing the amount of lumber or materials required for the supporting structure. In effect, the three supporting members in the prior art have been repositioned in accordance with the present invention to produce a much more stable unit without adding to the lumber required. Thus, the increased stability is achieved without substantially increasing the cost.

Referring now to FIGS. **3, 4** and **5**, the importance of the supporting structure for the pallet-like unit of FIG. **1** in the formation of a biological filter media array can be better understood. As will be seen in FIG. **4** and **5**, a plurality of pallet-like units have been positioned on an underdrain structure, which includes runners **41** mounted on a concrete foundation **42.** The foundation **42** preferably tapers from end **43** to end **44,** for flow of underdrain or filter effluent in that direction. Distribution apparatus for distributing liquid wastes over the top of the filter has not been shown, but a number of different types of apparatus are commonly employed, including swing — arm apparatus and stationary standpipes. Runners **41** are preferably tapered in a manner so that the upper surfaces **46** are level in order to better support the filter media.

The improved stability of the overall filter media array and the individual pallet-like units comprising the array can best be understood by reference to FIG. **3.** In FIG. **3** two layers (the top layer and next vertically adjacent layer) of the filter media array of the present invention are illustrated. All of the individual units in the lower of these two layers are constructed as shown in FIG. **1.** Therefore, they each have a plurality of first runners **22** and **22*a*** and a substantially perpendicularly oriented second supporting member **26,** as can be seen in connection with the unit generally designated **51.** The individual laths in each unit are not shown for the purpose of simplicity. Thus, the first layer is comprised of units **51, 52, 53, 54, 55, 56** and **57,** all of which are identically formed and are formed as described in connection with FIG. **1.**

In order to provide a filter media array which is stable and self-supporting and which is further of more uniform height, the next vertically adjacent, horizontally extending, layer of units has been horizontally displaced so that units overlap a substantial portion of at least two units therebelow. Perhaps, the best example is in connection with unit **61** which is similarly formed with supporting members **22** and **22*a*** and cross member **26.** As will be seen in FIG. **3,** unit **61** has been positioned so that approximately one quarter of its area overlaps unit **51,** a second quarter overlaps unit **52,** and a third quarter overlaps unit **54,** and a fourth quarter overlaps unit **55.** Thus, unit **61** is positioned so that it overlaps four individual units in the layer below to provide an interlocking or connection of these units in both the X and y directions, or in mutually perpendicular directions. Although the layers of units comprising the filter array of the present invention are not fastened together, but are merely stacked one upon the other, the frictional engagement of these units in overlapped relation results in the weight of the units being used to tie the stacks together in a manner substantially enhancing the overall stability of the array. Units **62** and **63** in the second array are formed in a manner identical to unit **61** and the units in the first layer. Basically, it is preferable that virtually all of the units in the array be substantially identically formed. Since an overlapping of units in vertically adjacent horizontal layers is a feature of the array of the present invention, however, it is desirable to provide a limited number of units which may be positioned at the ends of the array in order to avoid gaps at the periphery of the media. One type of end unit is illustrated by units **66** and **67,** which are half length units including supporting members **22** and **22a,** but not cross member **26.** A second type of end unit is illustrated by unit **69,** which has the same length as unit **63,** but is half again as wide as unit **61.** As will be seen, unit **69** includes three first supporting members, namely, members **22, 22a** and **22b.** Formation of unit **69,** as shown in FIG. **3,** picks up the space that is exposed in unit **51** and **52.** Finally, two other types of end units are illustrated in the second layer, namely, unit **71,** having the same width as unit **69** but half the length, and the unit **72,** which is formed substantially the same as units **66** and **67,** only with the addition of second supporting member **26.** While the use of end units to fill in the periphery of the array is not absolutely necessary, failure to use these end units will result in gaps such as **73** and **74** adjacent the periphery (best seen in FIG. **4**) which will reduce the overall effectiveness of the filter array to some small extent, depending upon the size of the array.

In addition to improving stability of the filter array by overlapping units in vertically adjacent layers, it is an important feature of the present invention that the units be overlapped so that the supporting structures of the vertically adjacent units are in alignment. Therefore, as will be seen in FIG. **3,** supporting structure **26** in unit **51** and supporting member **26** in unit **61** are aligned. Furthermore, supporting member **22** in unit **51** can be seen to be aligned with members **22** in units **66** and **61,** as best may be seen at the gap between units **66** and **61.** It is the superimposition or vertical alignment of the supporting structures which creates an overall filter array having substantial strength and therefore capable of stacking to virtually any height. The alignment of the supporting structures further il-

lustrates the importance of having a second supporting member **26** transverse to the first supporting member **22.** As will be seen in FIGS. **3, 4** and **5,** the supporting members **26** line up to form a shear resistant wall, such as shear resistant walls **81, 82** and **83** in FIG. **5.** Similarly, supporting members **22** are aligned, even though the layers are overlapping, and form shear resistant walls **86–90.** Since the vertically extending walls **86–90** are perpendicular to the vertically extending walls **81–83,** an array of units is constructed which is very stable and will resist forces applied to the sides of the array. It should be noted further that the supporting members **22** forming the shear resistant walls **86–90** break up any tendency of the liquid waste to run along the longitudinal axes of the lath toward one side of the array.

In certain applications it may be preferable to form the basic pallet-like unit, which is the building block of the filter media array of the present invention, of a size such as shown for unit **69** in FIG. **3,** that is, using three first supporting members instead of two. Additionally, it would be possible to form the pallet-like units of the present invention of even a greater number of first supporting members, and it would be further possible to add additional cross or second supporting members parallel to member **26.** In order to provide overlapping of units in which the supporting members align to form shear resistant walls stabilizing the array, a generalized formula for the positioning of the supporting members with respect to the periphery of the rectangular array can be employed. If there are to be a number of first supporting units, the first of said first supporting units should be positioned laterally of a first side such as the side of the unit on which ends **23** fall in FIG. **1,** a distance equal to about $\frac{1}{2}n$ times the length of said surfaces, with each subsequent of said first supporting members being positioned from the laterally adjacent first supporting member by a distance equal to about $1/n$ times the length of said surfaces. Thus, in FIG. **1,** where there are two first supporting members, namely, members **22** and **22***a*, member **22** is positioned at about one quarter of the length of lath **21** from a first side defined by ends **23** and first supporting member **22***a* is positioned laterally of member **22** by a distance equal to about one half of the length of surfaces **21.** Unit **69** has three first supporting members, with the first one being positioned at about one sixth of the length of the laths from one edge, defined by the ends of the laths, and each subsequent first supporting member being spaced by a distance of one third of the length of said laths. A similar rule can be used in connection with cross members **26.** In FIG. **1,** only one cross member is employed, but it is positioned as though there would be two, namely, as though *m*, the number of second supporting members, equaled two, and therefore member **26** is positioned at about one quarter of the distance between the second sides of said units, namely, laths **31** and **32.** It would be possible to position an additional second supporting member at a distance of about one half the distance between laths **31** and **32** from cross member **26,** and this would increase the overall strength of the unit. The use of an additional cross-member, however, will result in increased weight and cost for the unit by reason of the extra lumber required. Accordingly, it is not preferable and not required in order to have a rigid unit that it be formed with an additional second supporting member.

As shown in FIGS. **3, 4,** and **5,** the alternate layers of the filter media array of the present invention have been horizontally displaced or staggered, which maximizes the stability and tends to minimize the effect of dimensional variations as you go up through the filter. When the filter is constructed of a very substantial height, for example, between 14 and 21 feet, overlapping of layers tends to cancel out deviations in the dimensions of individual units. It should be noted, however, that it is not necessary to stagger alternate layers, and substantial advantage will accrue if every third or every fifth layer is staggered, with the remaining layers being vertically aligned. The greater the number of aligned layers in a stack between the staggered layers, however, the greater will be the tendency for the stacks to become uneven and less stable. It should be noted, however, that the use of second supporting members transverse to the first supporting members in order to form the basic building units, will result in a stack of units which is more stable against forces from the sides of the stack than prior unit constructions, even if the overlapping array of the present invention is not employed. Finally, as is shown in FIGS. **3, 4, 5,** the gaps between the side-by-side pallet-like units have been exaggerated for the purpose of better illustrating the overlapping of the present invention. In actual practice, the units are positioned in substantially touching relation so that the positioning of the supporting members with relation to the units is not materially affected by the gaps between adjacent units.

In constructing the units of the present invention it is preferable that laths **21** are nailed or stapled to first supporting members **22** and **22**a, both of which are notched at **28** for receipt of cross-member **26.** The second supporting member **26** is preferably not inserted and secured to the unit at the place of manufacture since this would prevent nesting of the assembled units for shipping. Accordingly, second supporting members are sent separated from the units to the place of installation of the filter. At the filter location the second supporting members **26** may be inserted into the units. As an additional feature of the present invention cross-members **26** may be of a length to span from one unit to another. Thus, member **26** in unit **61** in FIG. **3** extends out over unit **62** and interlocks with supporting member **22** therein. This allows units **61** and **62** to be tied together physically in addition to the friction forces holding adjacent units together by reason of the overlapping of units. Tying units together by means of support member **26** is readily accomplished at the filter site since it is preferable that member **26** be added at the filter in any event because of the nesting problem.

I claim:

1. A filter media for the treatment of liquid waste, said media including a plurality of pallet-like units stacked in an array comprised of vertically superimposed horizontally extending layers each having a plurality of units positioned in side-by-side relation therein, each of said units including a plurality of horizontally extending surfaces secured to a supporting structure to form a self-supporting unit, the improvement comprising:

an array having units formed with a supporting structure having at least two mutually perpendicularly oriented and extending supporting members with said surfaces being secured thereto; and

an array having a plurality of said horizontally extending layers positioned with the units in one of said plurality of layers being horizontally displaced relative to a vertically adjacent layer of said plurality of units, with individual units in said horizontally displaced layer over-lapping a substantial portion of at least two units in said next vertically adjacent layer.

2. A filter media array as defined in claim **1** wherein, said surfaces in said units are provided by a plurality of laths and a first of said supporting members is mounted in substantially perpendicular relation to said laths, and a second of said supporting members is mounted in substantially perpendicular relation to said first supporting member and substantially parallel to the longitudinal axes of said laths.

3. A filter media array as defined in claim **2** wherein, said supporting members include an additional first supporting member mounted in relative superimposed relation to said laths and in laterally spaced generally parallel relation to said first supporting member to intersect each of said laths, said additional first supporting member being mounted intermediately of the ends of said laths and intersecting and being secured to said second supporting member, said laths being secured to said additional first supporting member.

4. A filter media array as defined in claim **2** wherein, said array is generally rectangular having a pair of first sides and a pair of second sides, said laths and said second supporting member being positioned to extend parallel to said second sides; and

a plurality of first supporting members each being mounted in relative superimposed and substantially perpendicular relation to said laths and being positioned in relative laterally spaced generally parallel relation to each other and said first sides, a first of said first supporting members being positioned laterally of one of said first sides a distance equal to about $\frac{1}{2}n$ times the length of said laths and each subsequent of said first supporting members being positioned from the laterally adjacent first supporting member by a distance equal to about $1/n$ times the length of said laths, where n equals the number of said plurality of first support members.

5. A filter media array as defined in claim **4** wherein, said second supporting member is positioned laterally inwardly of one of said second sides a distance equal to about one quarter of the length of said first sides, and extends beyond said unit for securement to a laterally adjacent unit.

6. A filter media array as defined in claim **4**, and

a plurality of second supporting members mounted in relative superimposed and substantially parallel relation to said laths and to each other, a first of said second supporting members being positioned laterally of one of said second sides a distance equal to about $\frac{1}{2}m$ times the length of said first sides and each subsequent of said second supporting members being positioned from the laterally adjacent second supporting member by a distance equal to about $1/m$ times the length of said first sides, where m equals the number of said plurality of second supporting members.

7. A filter media array as defined in claim **1**, wherein, said horizontally extending surfaces are provided by a plurality of lath members positioned in parallel relatively spaced relation and secured to at least two generally parallel relatively spaced supporting members running perpendicularly to said lath members intermediately of the ends thereof, said supporting structure further including a supporting member oriented perpendicularly to said first named supporting members at a position intermediate the ends of said unit; and

wherein said units in said horizontally displaced layers are positioned to overlap units in said next vertically adjacent layer with the members comprising said supporting structure in said units in said displaced layer being substantially in a vertical alignment with said supporting structure in said units in said next vertically adjacent layer.

8. Afilter media array as defined in claim **7**, wherein, alternate layers of said array are horizontally displaced, and

said units are generally rectangular and units in said horizontally displaced overlap a substantial portion of units in the next vertically adjacent layer in two mutually perpendicular directions.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,750,887 Dated August 7, 1973

Inventor(s) EDWIN R. CARLSON

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 8, line 42, after "displaced" insert ---layers---.

Signed and sealed this 6th day of August 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334