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2,768,431

APPARATUS AND METHOD FOR ASSEMBLY OF RODS AND PLATES

Filed May 14, 1953

5 Sheets-Sheet 1

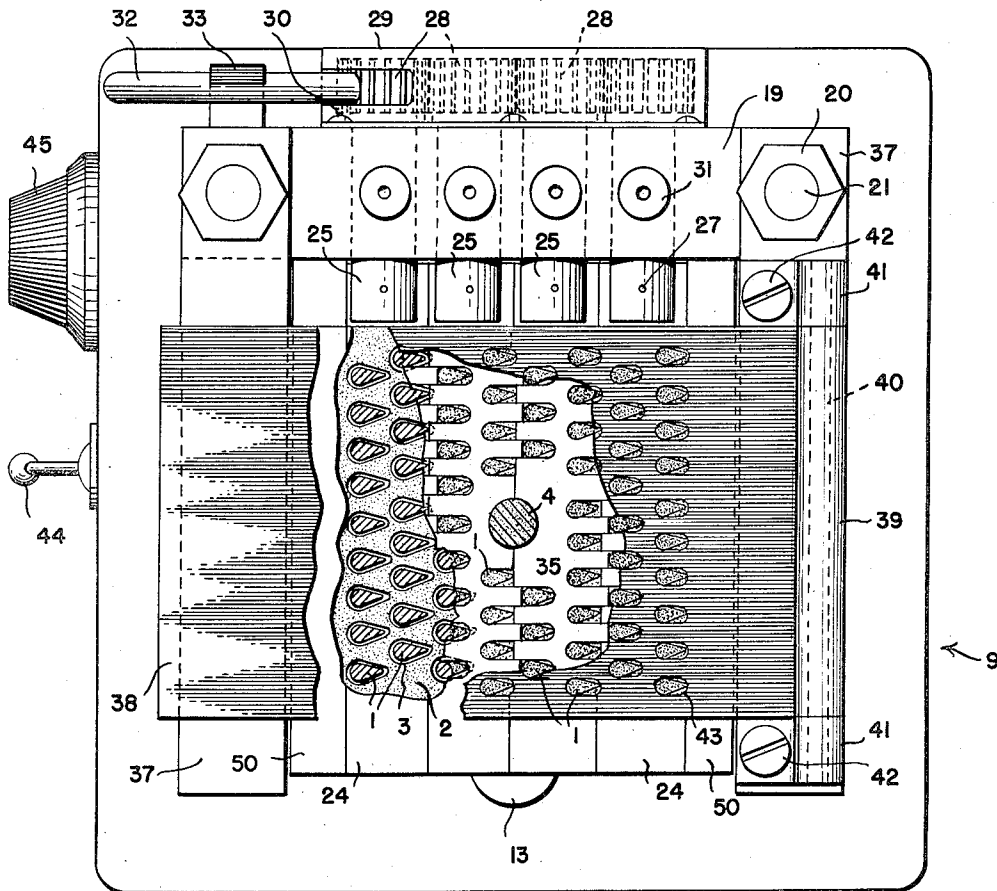


FIG. 5.

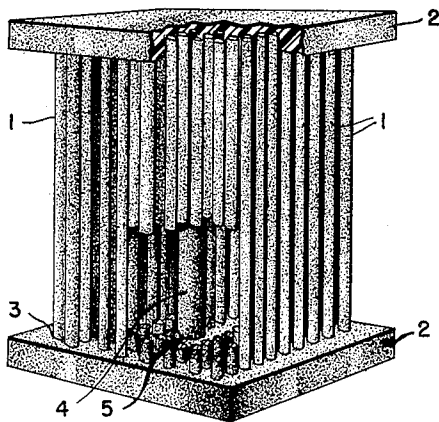


FIG. 1.

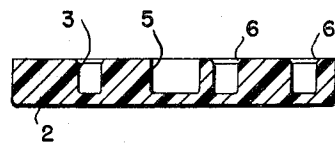


FIG. 2.

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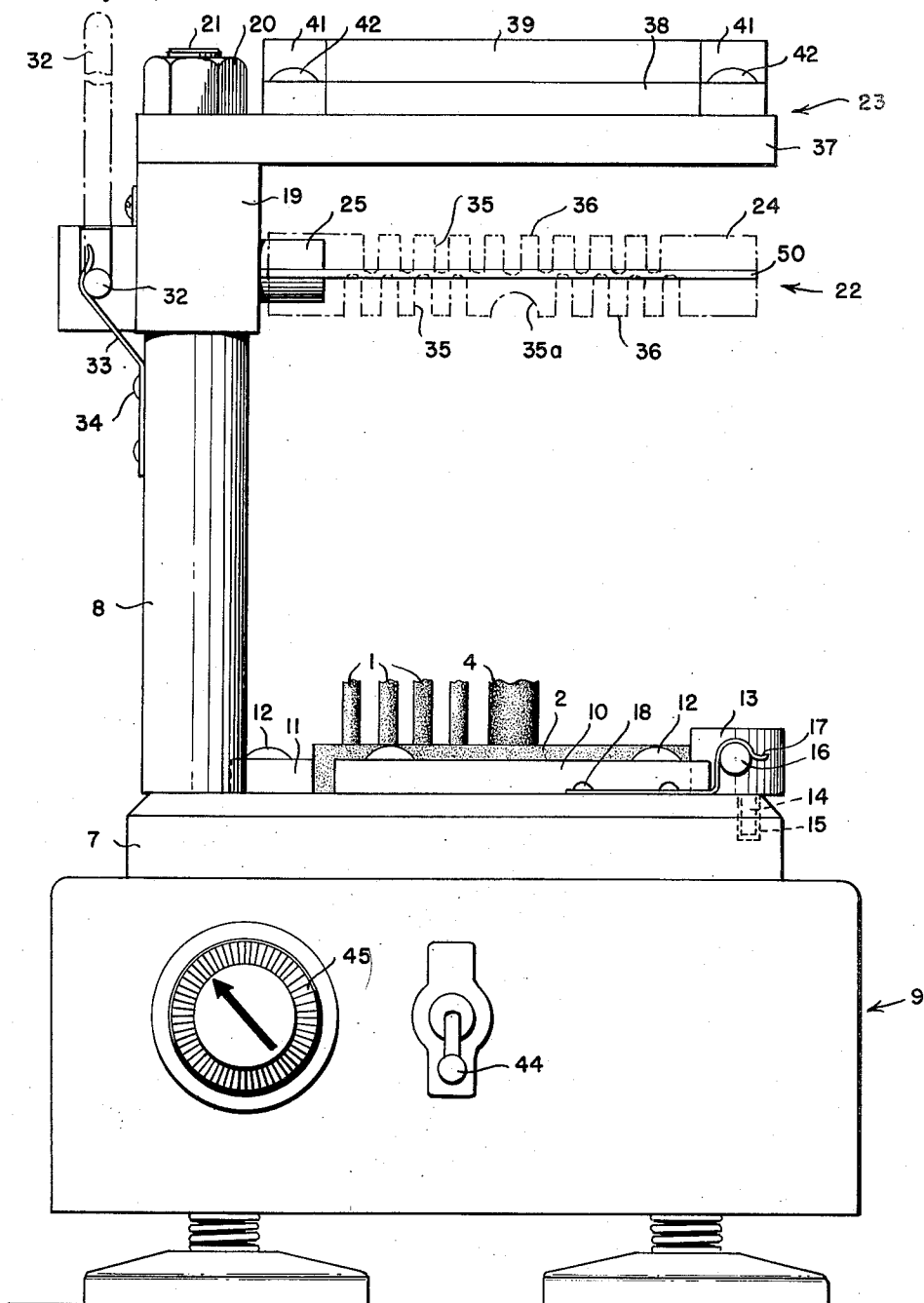
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FIG. 4.

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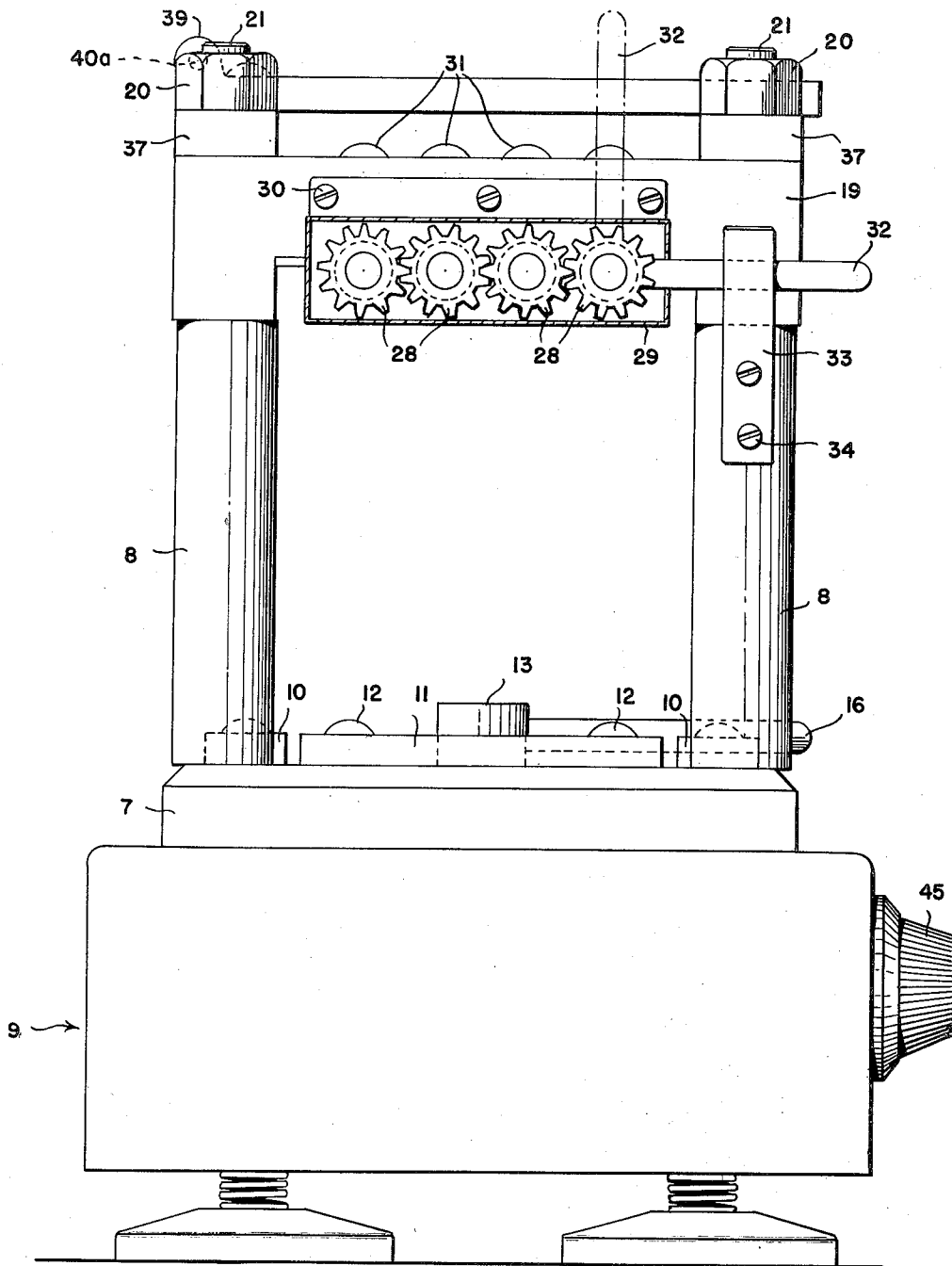


FIG. 6.

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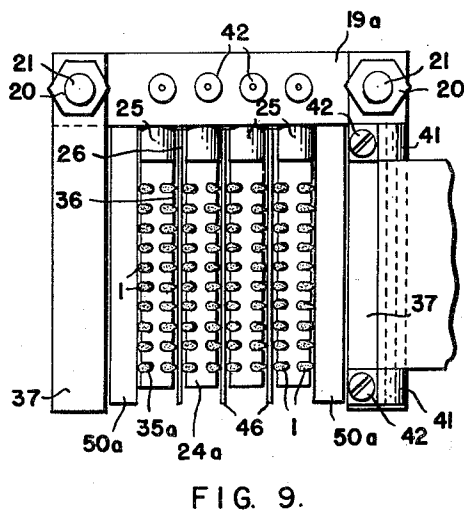
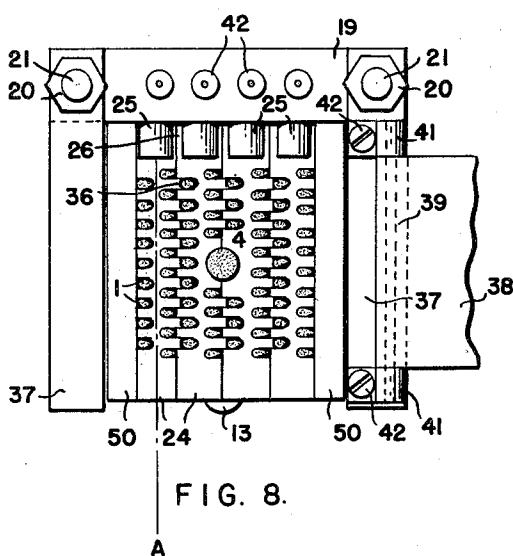
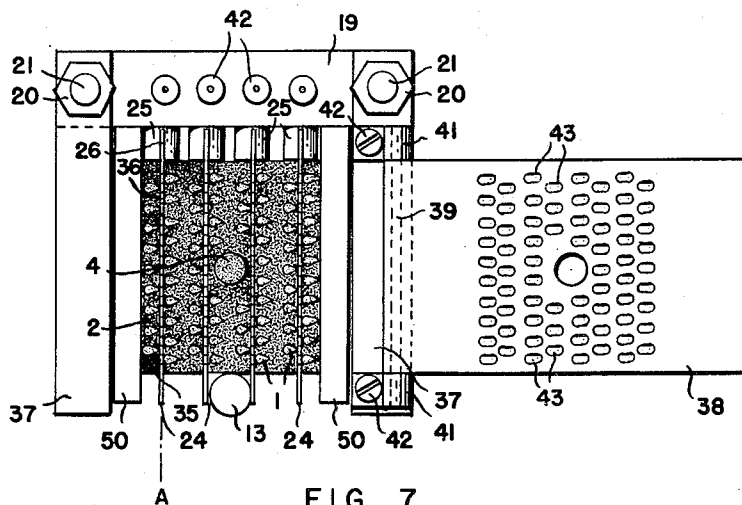
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APPARATUS AND METHOD FOR ASSEMBLY OF RODS AND PLATES

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APPARATUS AND METHOD FOR ASSEMBLY OF RODS AND PLATES

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Application May 14, 1953, Serial No. 354,985

4 Claims. (Cl. 29—428)

This invention is concerned with a method and apparatus to assist in the assembly of units comprised of a number of rods supported between a pair of end plates which is provided with apertures to receive them. The assembly of units of this type presents a difficult problem, particularly when the rods making up the unit are disposed in closely spaced relation.

It is an object of the invention to provide a relatively simply constructed and easily operated assembly jig to assist in the assembly of such units.

It is a further object of the invention to provide a method of assembly which permits such units to be assembled with greatly increased rapidity and ease.

To facilitate understanding of the invention, reference is now made to the accompanying drawings which illustrate a preferred embodiment of an assembly jig constructed in accordance with the principles of the invention. In the drawings:

Fig. 1 is a perspective view, with parts broken away, of a typical unit which may be quickly and easily assembled using the apparatus and method of the invention;

Fig. 2 is a cross-sectional view through the center of one of the end plates making up the unit illustrated in Fig. 1;

Fig. 3 is a front plan view of an assembly jig constructed in accordance with the invention, shown containing a partially assembled unit of the type illustrated in Fig. 1.

Fig. 4 is a side elevation of the jig illustrated in Fig. 3;

Fig. 5 is a top plan view of the jig illustrated in Figs. 3 and 4, with parts broken away, showing a partially assembled unit of the type illustrated in Fig. 1;

Fig. 6 is a rear view of the jig illustrated in Figs. 3, 4, and 5 with parts in section;

Fig. 7 is a top plan view of a portion of the assembly jig illustrated in the previous figures, shown in one operative position;

Fig. 8 is a view similar to Fig. 7, showing a portion of the assembly jig in another operative position; and

Fig. 9 is a top plan view showing a different arrangement of one portion of the assembly jig adapted for the assembly of a unit of somewhat different construction than that illustrated in Fig. 1.

Referring now to Fig. 1, the unit illustrated in this figure consists of a plurality of rod-like elements 1 which are supported between a pair of end plates 2 provided with apertures 3 to receive them. In the particular unit illustrated, the apertures 3 are sized slightly larger than the rods 1 to permit the rods to be retained in these apertures with a loose sliding fit. The end plates 2 are supported by a sturdy center post 4 which is cemented in sockets 5 provided in either end plate. To facilitate assembly, the edges of the apertures 3 are bevelled as at 6 (see Fig. 2) permitting the rods 1 to register more easily with these apertures during assembly. In the

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particular unit shown, the rods 1 and the apertures 3 are tear drop in cross-section as may be seen in Fig. 5.

The unit illustrated in Fig. 1 is described and claimed in copending application Serial No. 159,191, filed May 1, 1950, by Eugene J. Houdry for "Process and Apparatus for Contacting Operations" now Patent No. 2,730,434. This unit, particularly when composed of ceramic material such as a high quality porcelain, is excellently adapted for carrying out reactions involving contact of gaseous reactants with a surface. In particular, such a unit in which the rods 1 are composed of a high quality porcelain may be provided with a thin film of an oxidation catalyst, and employed in this form as a catalytic unit for carrying out catalytic oxidation reactions in the fluid phase, the fluid reactants flowing through the unit in contact with the rod-like elements 1. To provide efficient contact between the fluid reactants and the catalytic surface, the rods 1 are closely spaced in staggered rows. This type of arrangement is easily observed in Figs. 5, 7, and 8 where it may be seen that the rods 1 are arranged in parallel rows, the rod-like elements in each row being staggered with respect to the units in adjacent rows.

Such units are preferably small in size, a typical unit having the dimensions of 3" x 3" x 6" and containing a total of 73 closely spaced rods in addition to the center post 4. Because of the close spacing and relatively small dimensions of these rods, the assembly of such a unit presents a rather difficult problem.

Although the invention will be illustrated with reference to the assembly of such unit, it is to be understood of course that the principles of the invention are equally applicable to the assembly of many other types of units of similar construction.

Referring now particularly to Figs. 3 and 4 which show respectively a front and side elevation of the assembly jig, it may be seen that the jig consists generally of a base 7 from which is supported an upright frame which includes a pair of upright posts 8. As illustrated in the drawing, the base 7 of the assembly jig is shown resting upon a vibrator unit generally designated by the reference numeral 9, the purpose of which will be described in detail hereafter.

On the base 7, two side cleats 10 and a rear cleat 11 are fastened by screws 12 to the base 7 to provide a frame for retaining the end plate 2, which is supported on the base with its apertured face up, in proper position. In order to lock the end plate 2 firmly in position, a locking cam 13 is provided, having an eccentric shaft 14 which is journaled with a sliding fit into a bore 15 provided in the front of the base 7. The cam 13 is provided with a lever 16 which may be locked into place by means of a spring latch 17 which is fastened to the base 7 by screws 18. In its unlocked position, the cam 13 may be readily removed, permitting the end plate 2 to slide off the base 7 toward the front of the jig, thus permitting it to be removed from the jig without lifting it off the base.

A beam 19 is supported on posts 8, and is held in place by nuts 20 which are threaded onto studs 21 which pass through beam 19 and are threaded into posts 8.

On the beam 19 two superimposed members are supported, the lower of these members being generally designated by the reference numeral 22, and the upper of these members being generally designated by the reference numeral 23. As will be explained in detail, each of these superimposed members provide a series of apertures in alignment with each other and with the apertures in the end plate supported on the base 7.

The lower member is made up of a plurality of flat elements 24 which extend horizontally from the rear to the front of the assembly jig. The flat elements 24 are

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each fastened to separate horizontal shafts 25 which are journaled in the beam 19, as may be best seen in Figs. 5 and 7. As may be seen in these figures, shafts 25 extend beyond beam 19 at both ends. At the forward end, each shaft 25 is provided with a slot 26 (Fig. 7) for receiving a flat element 24 which is held in place by a pin 27 (Fig. 5). At the opposite end, the shafts 25 are provided with gears 28 which mesh with one another as may be best seen in Figs. 5 and 6. Gears 28 are protected by a casing 29 which is fastened to the beam 19 by screws 30 (see Figs. 5 and 6). Each of the shafts 25 are provided with a separate lubrication nipple 31.

A lever 32 is connected to one of the shafts 25 as can be best seen in Figs. 5 and 6. Rotation of lever 32 from the horizontal to the vertical position (indicated in dotted lines in Figs. 4 and 6) causes the shafts 25, through the agency of gears 28, to rotate in synchronization through an angle of 90°. Lever 32 may be locked in the horizontal position by means of a spring latch 33 which is fastened to post 8 by means of screws 34.

When the lever 32 is in the horizontal position, the flat elements 24 lie in the horizontal plane. A plan view of the elements 24 in the horizontal position may be seen in Figs. 5 and 8, while a front elevation of the elements 24 in the horizontal position may be seen in Fig. 3. When the lever 32 is moved to the vertical position, the flat elements 24 are rotated to a vertical plane. A plan view of the elements 24 in the vertical position may be seen in Fig. 7, while Fig. 4 shows in dotted lines a side elevation of one of the elements 24 in this vertical position.

As may be best seen in Fig. 8, each of the elements 24 are of approximately the same width as that occupied by two adjacent rows of rods and are each provided with a series of notches 35 along their length on both sides. These notches are so arranged that in the horizontal position of the elements 24, a series of apertures are provided in alignment with the apertures 3 in the end plate supported on the base 7 (see Fig. 5). Rods 1 are retained in the apertures provided by elements 24 at a point intermediate their length and held in this manner in proper alignment during assembly operations. The manner in which the rods 1 are supported by the elements 24 during assembly is best seen in Figs. 3, 5 and 8.

When assembling a unit such as that illustrated in the drawings, in which the rods in adjacent rows are staggered with respect to one another, the notches 35 in adjacent elements are arranged in staggered relation such that the unnotched portions 36 of one element 24 serve to retain the rods in rows adjacent to that element in their respective notches as is best illustrated in Figs. 5 and 8. In the embodiment illustrated, the unnotched portions 36 project somewhat into the opposite notches so that the elements 24 intermesh with one another when in the horizontal position. The two center elements 24 are provided with semi-circular notches 35a to provide an aperture for receiving the center post 4. To retain the rods in the outermost rows in their respective notches, a pair of flat elements 50 are attached immovably to the beam 19, extending therefrom horizontally and lying in the same plane which elements 24 occupy when in their horizontal position.

The axis of rotation A (see Fig. 8) of each of the elements 24 lies between a pair of adjacent rows of rods as best seen in Figs. 7 and 8. Thus, when rotated to the vertical position as shown in Fig. 7, the rods are released from the notches 35. The elements 24 in this position extend freely between the parallel rows of rods, permitting the assembled unit to be removed from the front of the jig by sliding it forward.

The upper apertured member, designated generally by the reference numeral 23 is supported from two horizontal bars 37 which are fastened on top of beam 19 by means of studs 21 and nuts 20. On one of the bars 37, the apertured plate 38 is hinged. Plate 38 is provided at one

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end with a flange 39 which has a longitudinal bore 40 for receiving hinge shaft 40a which also passes through a pair of blocks 41, fastened at either side of plate 38 to bar 37 by screws 42. Hinged in this manner, the plate 38 may be swung back from its closed position as shown in Figs. 3, 4, 5 and 6 to an open position as shown in Figs. 7 and 8. Plate 38 is provided with apertures 43 which, as best illustrated in Fig. 5, are in alignment with the apertures provided by elements 24 and with the aperture 3 in the end plate resting on the base of the assembly jig.

The vibrator unit, generally designated by the reference numeral 9, on which the assembly jig rests need not be described in detail since units of this type are well known and are commercially available. The particular unit shown operates on electric power and is controlled by an on-off switch 44, and is provided with a control knob 45 for controlling the intensity of vibration. Preferably, means (not shown) are provided for holding the base of the assembly jig firmly to the vibrator platform.

In operation, the first step is to place one of the end plates of the unit to be assembled on the base 7 with its apertured face up, the end plate being locked in place by means of the locking cam 13. Elements 24 are rotated to the horizontal plane, and the hinged apertured plate 38 is brought into its closed position as illustrated in Fig. 3 of the drawing. When this is done, the apertures 43 in the plate 38, the apertures provided by the notched elements 24 and the apertures 3 in the end plate are all in alignment with one another.

The rods 1 are then dropped by gravity through the apertures 43 and notches 35 which together align the rod approximately with the apertures 3 in the base plate. At the left in Fig. 3, a rod is shown falling into place after having been inserted through the apertured plate 38 and the notched element 24. Because of the tolerances in the manufacture of the rods themselves and in the spacing of the apertures in the end plates, apertures 43 and notches 35 are slightly oversized and accordingly the rods do not align themselves perfectly with their apertures in the end plate in every case when dropped through apertures 43 and notches 35 in this manner. On reaching the bottom of its fall a rod will often strike the surface of the end plate without registering with its aperture. To cause registration of these rods which come to rest on the surface of the end plate vibrator 9 is employed, through means of which vibration is imparted to the entire assembly jig causing the rods resting on the surface of the end plate near their respective apertures to quickly register with and drop into their proper apertures.

Fig. 3 shows a unit in place on the assembly jig which has been partially assembled in this manner. After being dropped in place it may be seen that the assembled rods are held in alignment by means of the notched elements 24. It will be noted that the rods in place terminate below the apertured plate 38.

In the particular unit shown, the rods 1 are held loosely in their respective apertures in the end plates, while the centerpost 4 is firmly anchored in sockets provided in either of the end plates so as to maintain the end plates in fixed relation. Accordingly, during assembly, the center post is preferably first dropped into position and anchored in place with a suitable cement.

After all the rods have been installed in the manner described above, the hinged plate 38 is then swung back exposing the tops of the upstanding rods held in approximate alignment in notches 35 provided by the elements 24. The second end plate is then placed into position with its apertures in approximate alignment with this assemblage of upstanding rods. By means of the vibrator 9, the entire assembly is then submitted to vibration which causes the rods 1 and the center post 4 to register substantially simultaneously with their proper apertures.

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In Fig. 3, the second end plate is shown in dotted lines in the position it occupies just after assembly.

The socket for the center post 4 is provided with a coat of a suitable cementing compound before this last assembly step so that when assembly is thus completed the two end plates will be securely anchored at either end of the center post.

The assembly of the unit being thus complete, the unit is ready to be removed from the jig. This is accomplished by moving the lever 32 from its horizontal to a vertical position causing the elements 24 to rotate through a 90° angle from a horizontal to a vertical plane, thereby disengaging the rods from the notches 35. In this position, which is best illustrated in Fig. 7, the elements 24 are completely disengaged from the rods and extend between the parallel rows of rods as illustrated in this figure. After unlocking and removing the cam lock 13, the assembled unit may then slide freely out of the front of the assembly jig.

It is of course understood that many variations are possible within the scope of the invention to adapt the unit specifically illustrated to take care of assembling units of varying construction. For example, if the rods in the unit to be assembled are arranged in rows which are not staggered, the arrangement shown in Fig. 9 may be employed. In this arrangement, elements 24a similar to elements 24, but of slightly different construction are employed. The elements 24a are also arranged to be rotated in synchronization from a horizontal to a vertical plane and are also provided with notches 35a along their length on both sides. However, because the rods in adjacent rows are directly opposite one another, additional means are necessary to retain the rods in their respective notches. This is provided in the arrangement illustrated in Fig. 9 by stiff rods 46 extending from the beam 19a in the same plane as elements 24a in their horizontal position. As in the case of the embodiment previously described, when the elements 24a are rotated to the vertical position, the rods become disengaged from the slots 35a, the elements 24a freely extending between the parallel rows of rods, permitting the assembled unit to slide forwardly from the assembly jig.

It will be clear that many other variations are possible within the spirit of the invention and that the scope of the invention is not limited to the specific embodiments illustrated, but should be determined by reference to the appended claims.

I claim:

1. An assembly jig for assembling a unit comprised of a plurality of rods supported between a pair of end plates provided with apertures to receive them which comprises a base for supporting one of said end plates during assembly operations, said base being provided with positioning means operative to position said one end plate thereon, a pair of superimposed members positioned above said base, each providing apertures in alignment with each other and with the apertures in the said one end plate as supported and positioned on said base, the lower of said members being made up of a plurality of horizontally extending elements arranged in side-by-side relationship and each being separately mounted for rotation about a horizontal axis, said elements being so constructed and arranged that when rotated to one position they together provide a series of apertures in which said rods are retained temporarily during assembly of said unit, and when rotated to a second position release said rods to permit the assembled unit to be removed from the jig, the upper member being spaced above the ends of said rods when in assembled position, and serving in cooperation with said lower member to align said rods with the apertures in said end plate as the rods are dropped into position.

2. An assembly jig for assembling a unit comprised of a plurality of parallel rows of rods supported between a pair of end plates provided with apertures to receive

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them which comprises a base for supporting one of said end plates during assembly operations, a pair of superimposed members positioned above said base, each providing apertures in alignment with each other and with the apertures in the end plates supported on said base, the lower of said members being so positioned as to engage said rods at a point intermediate their length to hold them in the proper alignment during assembly, and being made up of a plurality of horizontally extending flat elements having a width approximating the width occupied by two adjacent rows of rods in the assembled unit, each element being provided with notches along its length on either side thereof adapted to receive said rods, said elements being arranged in side-by-side parallel relationship, each being separately mounted at one end for rotation about a horizontal axis to permit the notched faces thereof to be moved to and from horizontal and vertical planes, the axis of rotation of each element extending between adjacent parallel rows of assembled rods whereby the rods in these adjacent rows are retained in the notches in the faces of said elements when these notched faces are in the horizontal plane, and whereby said rods are released from said notches, permitting the assembled unit to be removed from the jig, when these notched faces are rotated to the vertical plane, the upper member being spaced above the ends of said rods when in assembled position, and serving in cooperation with said lower member to align said rods with the apertures in said end plate as the rods are dropped into position.

3. An assembly jig for assembling a unit comprised of a plurality of parallel rows of rods supported between a pair of end plates provided with apertures to receive them which comprises a base for supporting one of said end plates during assembly operations, said base being provided with positioning means operative to position said one end plate thereon, said base also being provided with clamping means operative to clamp said one end plate during the assembling operation, an upright frame supported from said base, a pair of superimposed members positioned above said base and supported on said frame, each providing apertures in alignment with each other and with the apertures in the said one end plate as supported and positioned on said base, said lower member being so positioned as to engage said rods at a point intermediate their length to hold them in proper alignment during assembly, said lower member being made up of a plurality of flat elements provided with notched faces extending horizontally from said frame and arranged in side-by-side parallel relationship, each being separately mounted at one end on horizontal shafts supported by said frame for rotation about a horizontal axis to permit the notched faces thereof to be moved to and from horizontal and vertical planes, the axis of rotation of each element extending between adjacent parallel rows of assembled rods whereby the rods in these adjacent rows are retained in the notches in the faces of said elements when these notched faces are in the horizontal plane, and whereby said rods are released from said notches, permitting the unit to be removed from the jig, when these notched faces are rotated to the vertical plane, the upper member being movably fastened to said frame in a position above the ends of said rods when in assembled position, and serving in cooperation with said lower member to align said rods with the apertures in said end plate as the rods are dropped into position, and being movable to permit the second end plate to be installed while said rods are held in place by said lower member, and vibrating means disposed beneath said base for subjecting the jig to vibration to assist in the assembly of said unit.

4. A method for assembling a unit comprised of a plurality of rods supported between a pair of end plates provided with apertures to receive them which comprises

the steps of supporting one of said end plates on a base with its apertured face up, dropping each rod by gravity into a position approximately in alignment with its proper aperture, subjecting said base to vibration while retaining said rods in said position of approximate alignment thereby causing said rods to register with and drop into said apertures, and thereafter placing the second end plate in a position on top of the assembly of upstanding rods held in approximate alignment with the apertures in said second end plate, and vibrating the entire assembly thereby causing said rods to register substantially simultaneously with the apertures in said second end plate.

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