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GAS ANALYSIS APPARATUS

2,026,842

Filed Oct. 11, 1933

2 Sheets-Sheet 1

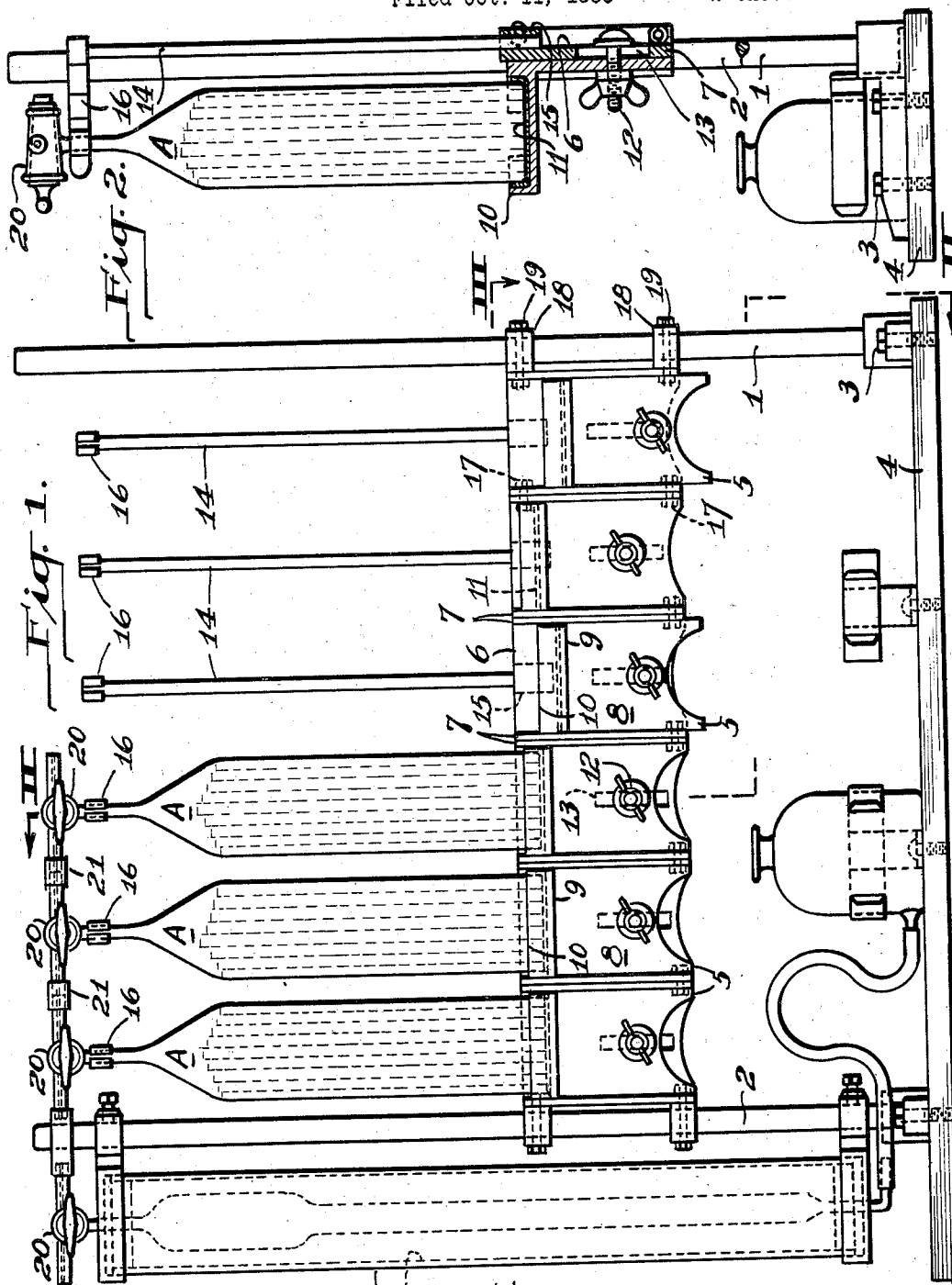


Fig. 1.

WITNESSES

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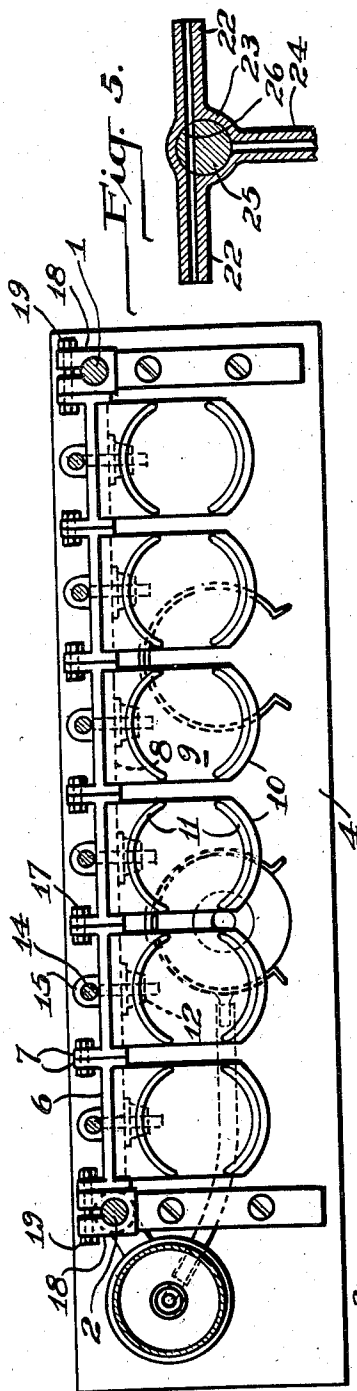
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2 Sheets-Sheet 2



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Fig. 3.

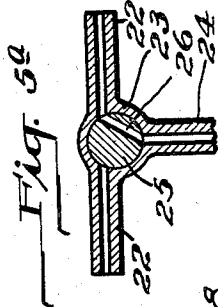


Fig. 5a

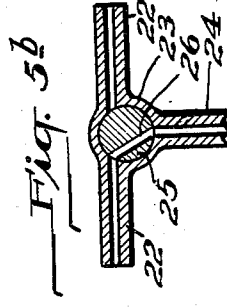


Fig. 5b

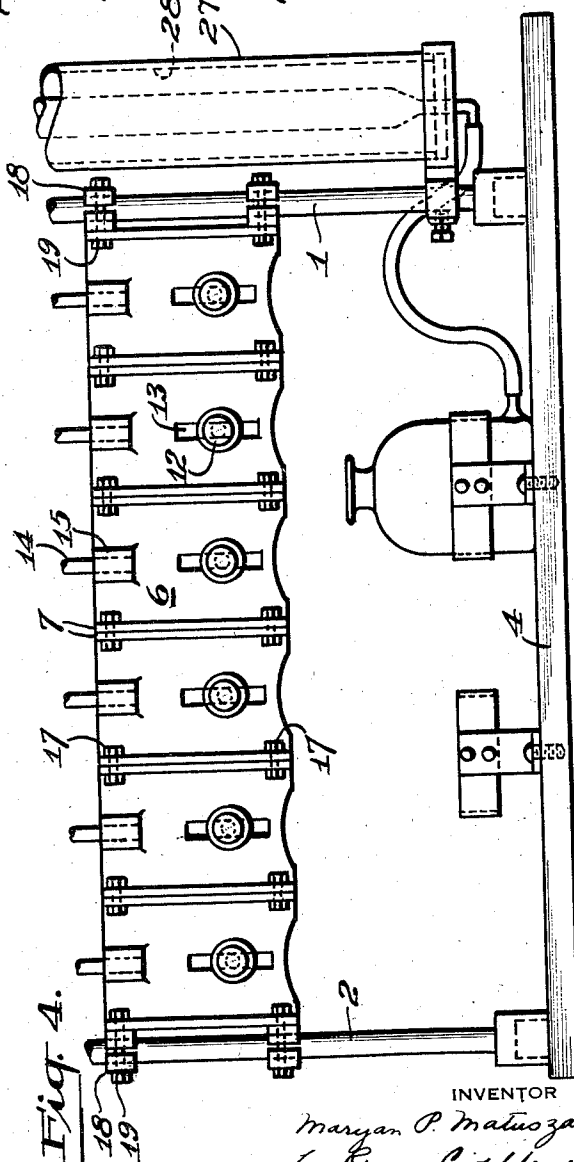


Fig. 4.

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UNITED STATES PATENT OFFICE

2,026,842

GAS ANALYSIS APPARATUS

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7 Claims. (Cl. 23—254)

This invention relates to gas analysis apparatus. There have been available two general types of constant pressure gas analysis apparatus. The first of these comprises a suitable number of individual Hempel pipettes which are in turn connected to and disconnected from the gas burette. Such apparatus is subject to the disadvantages that it is not of the unitary type, each pipette being mounted in its own separate or individual frame, so that although any number of elements can be used the apparatus is bulky and it is not readily made portable. The use of such apparatus is tedious because of the numerous connections and disconnections that must be made in conducting an analysis.

The other form of apparatus for this purpose is commonly designated as the Orsat type. Orsat apparatus is made readily portable, but various other and important features are sacrificed. As previously constructed each Orsat apparatus embodies a rigid assembly of fixed size, i. e., a box-like enclosure and supporting frame of fixed size containing a certain number of gas analysis elements, such as absorption pipettes, beyond which the apparatus as originally constructed may not be readily expanded.

It is also characteristic of Orsat apparatus that a one-piece rigid glass manifold is generally used for directing the sample to the various analytical elements. Such a manifold is fragile and expensive, it is hard to clean, and it tends to introduce inaccuracies in the results, such as the so-called capillary error.

Furthermore, the one-piece manifold of the Orsat apparatus, like its framework, is of fixed character, so that it is not adaptable to the use of additional or special functional elements.

By virtue of the rigid framework and fixed construction of Orsat apparatus a given assembly is adapted for analysis of a given type of gas mixture but is not readily adaptable to other types of work. Thus, if it is desired to increase the number of analytical elements, or to introduce special elements varying in character and construction from those for which the assembly was intended, extensive reconstruction of the framework is necessary. This entails expense and difficulties of re-designing, and it may render the modified structure bulky, clumsy and not easily portable.

This feature has militated against the Orsat type apparatus, offering handicaps to its use, particularly for research purposes. And in some instances desirable changes in procedure are virtually precluded. As an illustration of this,

it is impossible with standard Orsat apparatus to adapt it so that one gas sample may be undergoing combustion while a second sample of gas is being subjected to absorption procedure, which would be highly desirable in many instances.

Despite these disadvantages of prior gas analysis apparatus, however, the art has lacked a supporting framework combining the desirable features of both the Hempel and Orsat types of gas analysis apparatus and eliminating their undesirable features.

It is among the objects of this invention to provide gas analysis apparatus, and a supporting framework therefor, which is of sturdy, simple and compact construction, is readily and quickly convertible to increase or decrease the number or arrangement of analytical elements, whereby it is convertible according to need, for using any number, combination or arrangement of gas analysis elements, so that a given set-up may be expanded or contracted without the major reconstruction necessary heretofore, is readily portable; which minimizes or eliminates various disadvantages of frameworks used heretofore for supporting gas analysis apparatus, in which the various parts are unitary and interchangeable; and in which the disadvantages of one-piece manifolds and prior types of stop-cock construction are avoided. Other objects will be recognized by those skilled in the art.

One embodiment of the invention is shown in the accompanying drawings, in which Fig. 1 is a front elevation of a framework adapted to support six analytical elements; Fig. 2 an end elevation and section, of the framework shown in Fig. 1, taken on line II—II thereof; Fig. 3 a top sectional view taken on line III—III, Fig. 1; Fig. 4 a fragmentary rear view of the apparatus; and Figs. 5, 5a and 5b sectional views through a preferred form of stop-cock used in the gas analytical elements.

In the framework of this invention unitary members each adapted to support a gas element, such as an absorption pipette, or a combustion tube, and the like elements used in gas analysis, are removably connected together to form a rigid analysis element-supporting means, and the composite unit thus provided is carried at its ends by suitably spaced rigid frame members whose spacing may be varied according to need. The number of the units may be increased or decreased, according to need, by inserting or removing units and by suitably shifting the spaced relation of the frame members. Most suitably the element-supporting means of the individual

units takes the form of a horizontal platform, and either the unit or its platform is adjustable vertically so as to permit the use of a straight line manifold irrespective of variations in vertical height of the individual analysis elements. The units also are connected in alignment to the same end. By making the units alike full interchangeability is provided, which lessens the expense and affords maximum simplicity and rapidity in effecting changes.

Having reference now to the drawings, the embodiment shown comprises a pair of vertical side frame members 1 and 2 spaced from each other and removably connected, as by means of bolts 3, to a suitable base 4, which may be a laboratory bench, or a suitable platform, or carrying case base. Frame members 1 and 2 are of rigid construction so that the completed apparatus will embody the rigidity necessary in such apparatus.

The analytical elements A, of which three are schematically indicated, are carried between the frame members by a supporting structure formed of a plurality of unitary element-supporting units 5 each having a horizontal platform for receiving the base of an element A, and the units being rigidly connected together by removable means. The supporting structure is connected at its ends to the frame members.

Advantageously the platform is adjustable vertically of the unit, and one means of accomplishing this is shown in Figs. 1 to 4. The units shown comprise a back plate 6 having at each side a flange 7 extending forwardly and rearwardly of the plate, as seen in Fig. 3. A front plate 8 provided with a horizontal element-supporting platform 9 extending forwardly therefrom, is mounted between the front ends of flanges 7, which act as side guides while permitting front plate 8 to move vertically therebetween. In the form shown platforms 9 are substantially circular, inasmuch as the analytical elements preferably used are of such form, and each platform is surrounded by an upwardly projecting rim 10, to hold the element in position on the platform. Platforms 9 may, of course, be of a form adapted to analytical elements of the more customary design in which two compartments are connected together at the bottom by an integral U-shaped tube. It is preferred also to cover the base with a layer of felt 11, to minimize danger of breakage of the glass apparatus when placed on the platform.

The platforms are vertically adjustable relative to the back plate, to permit the use of a straight line manifold, as indicated in Fig. 1. To this end any suitable means may be used for adjusting front plate 8 relative to back plate 6 and for locking it in adjusted position. In the embodiment shown a bolt 12 extends rearwardly through front plate 8 and through a vertical slot 13 formed in back plate 6, to act as means for compressing the two plates together to hold the front plate in adjusted position. When bolt 12 is loosened front plate 8 may be moved upwardly or downwardly, to compensate for differences in height of elements A, and then locked in position by tightening the bolt. In Fig. 1 four of the front plates are shown locked at one level, and two of the elements at different levels, to indicate such adjustment.

Preferably each of the units is also provided with means for holding the elements rigidly in place. To this end each unit is preferably provided with a vertical rod 14 carried by the back plate, as for instance by a lug 15. Rods 14 act then to carry means for clamping the elements

near their upper ends. This may be accomplished simply by spring clips 16 connected to the rods and adapted to snap around the neck of the element, as indicated by the three elements shown in Fig. 1.

The units are connected together to form a rigid composite element-supporting structure which may be modified at will by introducing or removing units. With the units shown this is accomplished by bolts 17 extending through 10 flanges 7 at the rear of back plates 6, as shown particularly in Fig. 4, the units being positioned side by side, with their flanges in contact and with the back plates aligned both longitudinally and vertically, as shown in Figs. 3 and 4. The supporting structure thus provided is carried at its ends, by any suitable means, as by frame members 1 and 2. Preferably each frame member carries a pair of slidable split ring members 18 whose bolt 19 extends through the contiguous 20 flange 7 of the back plate 6 of the adjacent end unit 5, as may be seen in Fig. 3. In this manner the supporting structure is carried rigidly by the frame rods, but it may be moved vertically thereof as need be.

There is thus provided a rigid, compact and sturdy framework for supporting gas analysis apparatus which is essentially unitary, but which may be modified at will to meet any condition required. The illustrative form shown embodies six units, so that it is adapted for uses requiring up to six analytical elements. If some particular analysis requires more elements it will be seen that these may be readily inserted in the structure between any two adjacent units 5, or between the end unit and the adjoining frame member, connecting them in the manner described and shown. The side members 1 and 2 are moved correspondingly farther apart. Or, if fewer elements are needed, the excess units are removed in a manner that will be apparent. The units comprising the analytical element-supporting structure are simple to use and install, and being standardized or interchangeable, necessary changes are effected quickly, without particular or unusual tools being required, and any assembly from a simple one-pipette apparatus, to the most elaborate, is readily and rapidly built up, with the accompanying features of simplicity, sturdiness and compactness, so that the apparatus is adapted to portable as well as laboratory uses.

The invention contemplates in its preferred embodiment the use of straight line manifolds, and this is made possible by vertical adjustment of the element-supporting platforms. The main conduit arms of the stop-cocks 20 of the elements used are then connected by short lengths 21 of rubber tubing at their ends, whereby the arms provide the desired straight-through manifold, as shown in Fig. 1.

This eliminates the inflexibility and fragility inherent in the one-piece Orsat manifold used heretofore, and experience shows that it reduces the number of connections that must be made. It provides a maximum of flexibility and adaptability with a minimum of fragility, which is particularly desirable when introducing or removing pipettes, and it eliminates the lack of adaptability of the prior types of one-piece manifold. Having the rubber connections in the horizontal line of the manifold also offers the advantage that the rubber connections are not continuously subjected to the action of vapors from the absorbents, because they are separated from the absorbents by stop-cocks, preferably integral with

the elements, which prevent contact between the vapors and the rubber connections when the apparatus is not in use. Accordingly the connections last longer and need not be replaced as frequently as in prior apparatus.

Further advantages are to be attained by the use of a special form of stop-cock whose construction may be understood best by reference to Figs. 5, 5a and 5b. This comprises a main conduit formed by a pair of side arms 22 connected to the stop-cock barrel 23 with their bores opening in alignment into the barrel in a plane above a parallel plane passed through the longitudinal axis of the barrel. The branch conduit of the stop-cock, leading to the pipette, is formed by a side arm 24 connected to barrel 23 in the plane of arms 22 but at right angles to them. The plug 25 of the stop-cock is provided with a straight bore 26 displaced above the axis in a manner similar to that of arms 22, so that in the position shown in Fig. 5 a straight-through main conduit run is provided. This construction provides also for connecting any two of the side arms by rotating the plug, in a manner which overcomes the disadvantages of prior types of three-way stop-cocks. The other two positions of the plug, for connecting the branch with either of the main arms, are shown in Figs. 5a and 5b. The construction shown and described embodies the advantage that the dead capillary spaces heretofore encountered in the vertical branches have been materially reduced by this cock construction, which places the stop-cocks in the line of the main capillary of the manifold. The special form of stop-cock shown renders the manifold completely flushable and easily cleaned, as by inserting a length of cotton-covered wire and pushing it completely through the manifold from one end to the other, and this can be done without removing any part of the apparatus. Such cleaning is not possible with other stop-cocks and manifolds available heretofore for this purpose.

The feature of flushability also permits the user to remove any absorbent that may accidentally have been passed beyond the stop-cock, without taking the apparatus apart. And this construction avoids the disadvantages that are present in three-way stop-cocks having L-, V-, or T-bore plugs, or 120° arm positioning, such as increased capillary space or trapping of small bubbles of gas.

It will be understood that other elements used in such an apparatus, such as burettes, sampling tubes or bulbs, and the like, may be supported from the side frame members, as indicated by gas burette 27 and water jacket 28, shown carried by means of ring supports 29 mounted on frame member 1. Also, additional rods, similar to those used for the side frames, may be mounted on the base for this purpose.

It will be understood that although the unit construction shown constitutes the preferred embodiment, the invention is not restricted thereto. Other forms of units, and other means of connecting them together and to the frame members, may be used, for example, while embodying the gist of the invention, viz., a unitized framework for supporting gas analysis apparatus which may be enlarged or made smaller quickly and easily with no change in the framework itself, while retaining advantageous constructional features, such as those described hereinabove.

The unitized construction which underlies the invention affords maximum flexibility of adapta-

tion to varying needs, enlarging all of the scope of applicability, as compared with prior frameworks, and providing by standardized construction elements a framework to fit every need. The number of pipettes and their arrangement is not limited, as it was with earlier frameworks used in Orsat type apparatus. The analytical elements may be shifted at will, as to number or disposition, for example to subject one sample to combustion while another is undergoing absorption, which is not possible with the Orsat type. Other advantages will be understood by those skilled in the art.

No claim is made herein to the novel stop-cock construction shown and described, claims thereto being presented in a co-pending application filed by me.

According to the provisions of the patent statutes, I have explained the principle and construction of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. Gas analysis apparatus framework comprising two rigid vertical frame members spaced from each other, a plurality of individual unitary supporting members carried by said frame members and each provided with a horizontally extending analytical element-supporting platform, said supporting members being arranged in alignment and rigidly connected together by removable connecting means adapted to permit the introduction or removal of units according to need, slide members carried by the frame members for adjustment vertically thereof and adapted to be locked in adjusted position, and means connecting the end units to said slide members.

2. Gas analysis apparatus framework comprising two rigid vertical frame members spaced from each other, a plurality of individual unitary interchangeable supporting members carried by said frame members and each provided with a vertically-adjustable horizontally-extending analytical element-supporting platform, means removably connecting said supporting members together in rigid alignment between said frame members and permitting the introduction or removal of units according to need, vertically-adjustable slide members associated with each of said frame members adapted to be fastened in adjusted position, and means connecting the end units to said slide members.

3. Gas analysis apparatus framework comprising two rigid vertical frame members spaced from each other, a plurality of individual unitary interchangeable analytical element-supporting members carried by said frame members and each composed of a vertical back plate, a front plate provided with a rigid horizontal platform extending forwardly therefrom, and means associated with said plates for vertical adjustment of the front plate relative to the back plate, said supporting members being arranged with their back plates in alignment between said frame members, means connecting said back plates together to rigidly hold said supporting units together and permit introduction or removal of units according to need, and means connecting the end units to said frame members.

4. Gas analysis apparatus framework comprising two rigid vertical frame members spaced from

each other, a plurality of interchangeable individual unitary analytical element-supporting members carried by said frame members and each composed of a vertical back plate provided with a vertical slot, a front plate provided with a rigid horizontal platform extending forwardly therefrom, and a bolt associated with the front plate disposed in said slot to permit vertical adjustment of said platform and locking of the platform in adjusted position, said supporting members being removably connected together between said frame members, vertically adjustable slide members mounted on said frame members adapted to be fastened in adjusted position, and means connecting the end units to said slide members.

5. Gas analysis apparatus framework comprising two rigid vertical frame members spaced from each other, a plurality of individual unitary interchangeable analytical element-supporting members carried by said frame members and each composed of a vertical back plate, a front plate provided with a rigid horizontal platform extending forwardly therefrom, means for fastening the front plate in vertically adjusted position relative to said back plate, and a clamping rod extending upwardly from said back plate, said supporting members being removably connected together between said frame members, vertically adjustable slide members carried by said frame members and adapted to be fastened in adjusted position, and means connecting the end units to said slide members.

6. Gas analysis apparatus framework comprising two rigid vertical frame members spaced from each other, a plurality of individual unitary interchangeable analytical element-supporting members carried by said frame members and

each composed of a vertical back plate having at each edge a flange extending forwardly and rearwardly of the plate, a front plate disposed between the flanges on the front side of said back plate and provided with a rigid horizontal platform extending forwardly therefrom, and means associated with said plates for adjusting the front plate vertically of the back plate, said supporting members being arranged with their back plates in alignment and removably connected together by bolts passing through the rear flanges, and means connecting the end units to said frame members.

7. Gas analysis apparatus framework comprising two rigid vertical frame members spaced from each other, a plurality of individual unitary interchangeable analytical element-supporting members carried by said frame members and each composed of a vertical back plate provided with a vertical slot and having at each edge a flange extending forwardly and rearwardly of the plate, a front plate disposed between the flanges on the front side of said back plate and provided with a rigid horizontal platform extending forwardly therefrom, and a bolt associated with said front plate disposed in said slot for vertical adjustment of the platform and locking of the platform in adjusted position, said supporting members being arranged with their back plates in alignment and rigidly connected together by bolts passing through the rear flanges, vertically adjustable slide members carried by the frame members and lockable in adjusted position, and means connecting the end units to said slide members.

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