Dec. 13, 1938. A. H. BRYAN 2,140,103

VALENCE BLOCK FOR ILLUSTRATING CHEMICAL REACTIONS

Filed July 22, 1937

FIG. 1.

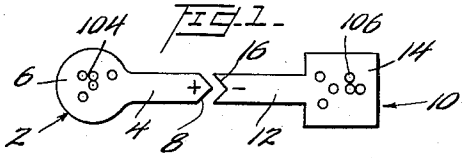


FIG. 2.

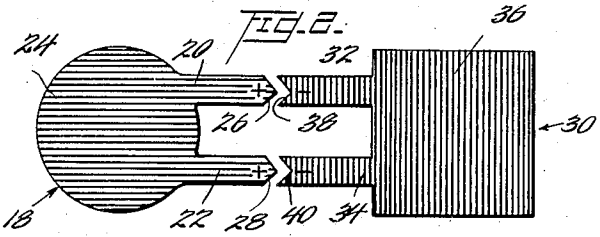


FIG. 3.

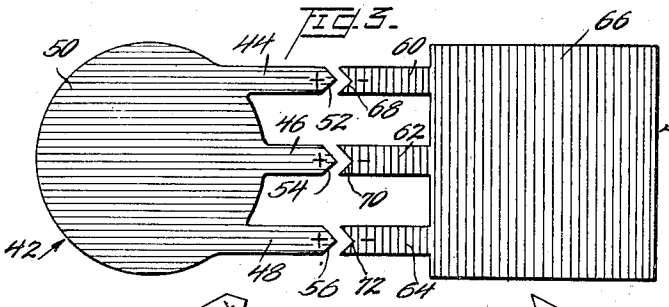


FIG. 4.

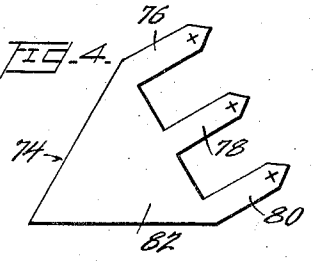


FIG. 5.

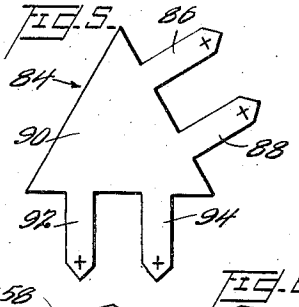


FIG. 6.

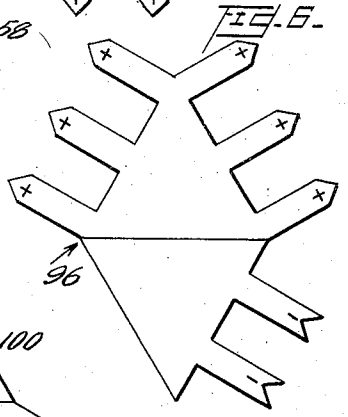


FIG. 7.

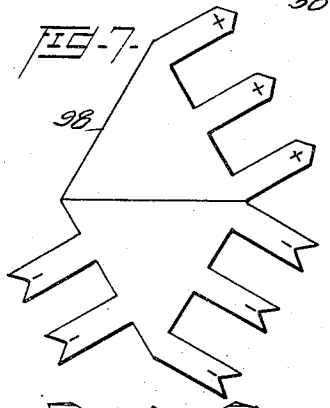


FIG. 8.

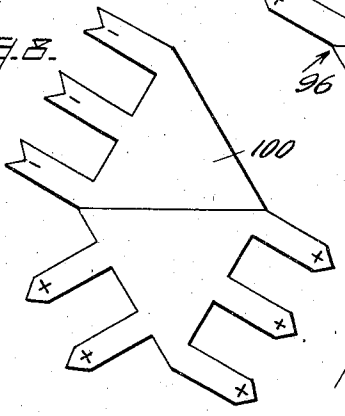


FIG. 10.

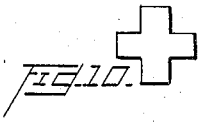


FIG. 9.

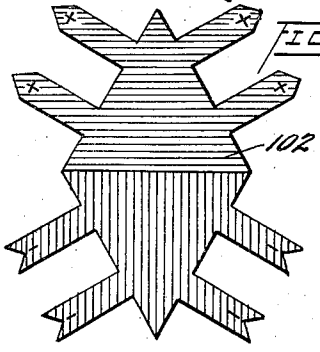


FIG. 12.

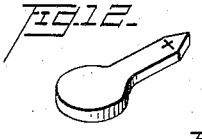


FIG. 11.

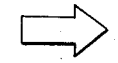
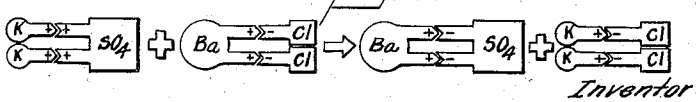


FIG. 13.



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VALENCE BLOCK FOR ILLUSTRATING CHEMICAL REACTIONS

Arthur Herbert Bryan, Baltimore, Md.

Application July 22, 1937, Serial No. 155,067

12 Claims. (Cl. 35—18)

This invention relates to devices for illustrating chemical reactions.

Among the objects of this invention is the provision of sets of blocks which can be used to illustrate chemical reactions and more particularly chemical reactions involving metathesis.

A further object of this invention is to provide blocks of this kind with characteristic configuration designed to represent positive chemical elements and radicals and blocks of other characteristic configuration designed to represent negative chemical elements and radicals, said blocks having projecting arms corresponding in number to the valence of the particular elements and radicals represented by such blocks, and the extremities of the arms on the blocks having distinct characteristic configurations for the positive as well as the negative elements and radicals.

A still further object of this invention is to provide these blocks with characteristic distinguishing colors for the positive and negative elements and radicals, the intensity of coloration being preferably in direct variation with the basic and acid powers of the designated chemical elements and radicals.

Other, further, and more specific objects of this invention will become readily apparent to persons skilled in the art from a consideration of the following description when taken in conjunction with the accompanying drawing wherein:

Fig. 1 is a plan view of my valence blocks which are employed for univalent elements and radicals.

Fig. 2 is a similar view of my valence blocks for bivalent elements and radicals.

Fig. 3 is a view, similar to Fig. 1, showing valence blocks for trivalent elements and radicals.

Figs. 4 to 9 are plan views of blocks showing the application of my invention to valence blocks for elements having two or more different valences.

Fig. 10 is a plan view of a block employed to show the plus sign in a chemical reaction.

Fig. 11 is a plan view showing the arrow employed in illustrating the direction of a chemical reaction.

Fig. 12 is a perspective view of a valence block for a monovalent positive element, such as shown in Fig. 1.

Fig. 13 is a plan view on reduced scale showing a complete chemical reaction employing my novel valence blocks.

In Fig. 1 the block **2** has the single arm **4** projecting from the main body **6** which is rounded. The end **8** of the arm **4** is wedge-shaped. I employ blocks of this configuration for monovalent elements with one positive (+) electron or ion, such as H, Li, Na, K, Cs, Rb, Ag, and for monovalent radicals with one positive (+) electron or ion, such as NH_4, CH_3 and C_2H_5. The block **10** in Fig. 1 has the single arm **12** projecting from the main body portion **14** which is rectangular. The end **16** of the arm **12** is grooved or otherwise recessed to receive and fit onto and mate with the wedge-shaped end, tongue or other suitable protuberance **8** of the arm **4** on block **2**. Blocks having the configuration of block **10** are used for the monovalent elements with one negative (—) electron or ion, such as F, Cl, Br and I, and for monovalent radicals with one negative (—) electron or ion, such as OH, ClO_3, ClO_4, NO_3, NO_2, HCO_3, BO_3, CN, and $C_2H_3O_2$.

In Fig. 2, the block **18** has the two arms **20** and **22** projecting from the main body portion **24** which is rounded. The ends **26** and **28** of the respective arms **20** and **22** are wedge-shaped. I employ blocks of this configuration for the divalent elements with two positive (+) electrons, such as Mg, Ca, Sr, Ba, Cd, Zn, and Ra. The block **30** in Fig. 2 also has two arms **32** and **34** projecting from the main body portion **36** which is rectangular. The ends **38** and **40** of the respective arms **32** and **34** are grooved to fit the wedge-shaped ends **26** and **28** of the respective arms **20** and **22**. Blocks having the configuration of block **30** are used for divalent elements with two negative (—) electrons, such as O and for divalent radicals with two negative (—) electrons, such as SO_4, CO_3, CrO_4, and Cr_2O_7.

In Fig. 3, the block **42** has the three arms **44**, **46** and **48** projecting from the main body portion **50** which is rounded. The ends **52**, **54** and **56** of the respective arms **44**, **46** and **48** are wedge-shaped. I employ blocks of this configuration for the trivalent elements with three positive (+) electrons, such as Al. The block **58** shown in Fig. 3 also has three arms **60**, **62** and **64** projecting from the main body **66** which is rectangular. The ends **68**, **70** and **72** of the respective arms **60**, **62** and **64** are grooved to fit onto the wedge-shaped ends **52**, **54** and **56** of the arms **44**, **46** and **48** of block **42**. Blocks of the configuration of block **58** are used for trivalent radicals with three negative (—) electrons, such as PO_4.

In Fig. 4, the block **74** has three arms **76**, **78** and **80** projecting from one side of the main body **82** which is triangular. The ends of the arms **76**, **78** and **80** are wedge-shaped. I employ blocks of this configuration for the elements Fe, Co and Ni, which have a valence of

two as well as a valence of three, with two and three positive (+) electrons, respectively.

In Fig. 5, the block 84 has two arms 86 and 88 projecting from one side of the main body 90 which is triangular, and two arms 92 and 94 projecting from another side of the triangular body 90. The ends of the arms 86, 88, 92 and 94 are wedge-shaped. I employ blocks of this configuration for the elements Pb, Sn and Pt which have a valence of two as well as a valence of four, with two and four positive (+) electrons, respectively.

In like manner, triangular blocks are employed with suitable numbers of arms for other elements having two or more different valences and the electrons all of one sign.

With elements having two or more different valences and possessing positive (+) electrons in some instances and negative (—) electrons at other times, the main body of my valence block is preferably of diamond-shape and formed by adjacent equilateral triangles, as in Figs. 6, 7, 8 and 9. The arms having the wedge-shaped ends and denoting positive (+) electrons, project from the sides of the equilateral triangle forming one half of the diamond-shaped body while the arms having the grooved ends and denoting negative (—) electrons project from the sides of the equilateral triangle forming the other half of the diamond-shaped body.

In Fig. 6, the valence block 96 has three arms with wedge-shaped ends projecting from each side of one half of the diamond-shaped body and two arms with grooved ends projecting from one side of the other half of the diamond-shaped body. I employ blocks of this configuration for the element S, which has a valence of two, with two negatives (—) electrons in some instances and a valence of six, with six positive (+) electrons at other times.

In Fig. 7, the valence block 98 has three arms with wedge-shaped ends projecting from one side of one half of the diamond-shaped body, two arms with grooved ends projecting from one side of the other half of the diamond-shaped body and three arms with grooved ends projecting from another side of the latter half of the diamond-shaped body. I employ blocks of this configuration for the element Sb, which has a valence of three, with three positive (+) electrons in some instances and a valence of five, with five negative (—) electrons at other times.

In Fig. 8, the valence block 100 has three arms with wedge-shaped ends projecting from a side of one half of the diamond-shaped body and two arms with wedge-shaped ends projecting from another side of the same half of the diamond-shaped body and three arms with grooved ends projecting from one side of the other half of the diamond-shaped body. I employ blocks of this configuration for the element As, which has valences of three and five, with three and five positive (+) electrons, respectively, in some instances and a valence of three, with three negative (—) electrons at other times.

In Fig. 9, the valence block 102 has two arms with wedge-shaped ends projecting from each side of one half of the diamond-shaped body and two arms with grooved ends projecting from each side of the other half of the diamond-shaped body. I employ blocks of this configuration for the element C, which has a valence of four, with four positive (+) electrons in some instances and a valence of four, with four negative (—) electrons at other times.

The spacing of the arms on the valence blocks is uniform throughout so that the wedge-shaped arms will readily fit into and mate with the grooved-shaped arms. The main body 6 of the univalent element 6 and the main body 14 of the univalent element 10 are of sufficient width so that, when two or more are placed alongside of each other, the spacing of the arms projecting therefrom will be substantially equal to the spacing between adjacent arms on blocks having two or more parallel arms.

The block for the plus sign shown in Fig. 10 and the block for the arrow shown in Fig. 11 are, preferably, substantially of the same thickness as the valence blocks.

A specific example of using my valence blocks is illustrated in Fig. 13 by the reaction

$$K_2SO_4+BaCl_2=BaSO_4+2KCl.$$

Here the K_2SO_4 is represented by three blocks, each of two blocks having one arm with wedge-shaped end for the monovalent element K with one positive (+) electron and one block having two arms with grooved ends for the divalent radical SO_4 with two negative (—) electrons. $BaCl_2$ is represented by three blocks, one block having two arms with wedge-shaped ends for the divalent element Ba with two positive (+) electrons and two blocks each having one arm with grooved end for the monovalent element Cl with one negative (—) electron. When the two substances K_2SO_4 and $BaCl_2$ react, metathesis takes place forming $BaSO_4$ and 2KCl, the valence block represented by Ba fitting onto the valence block represented by SO_4 and each valence block represented by K fitting onto a valence block represented by Cl. The valences of all the blocks are thus satisfied.

An additional feature of my invention will be seen by reference to Fig. 1 wherein the blocks 2 and 10 are provided with point print or Braille letters 104 and 106, showing a method for adapting my invention for the use of blind students and other sight handicapped persons when the blocks are used tactually.

A further feature of my invention will be seen by reference to Figs. 2 and 3. In Fig. 2 the block 18 is colored blue, while the valence block 30 is colored red. This arrangement is in conformity with the basic and acid color reactions to litmus. The valence blocks representing elements and radicals with positive (+) electrons may thus be colored blue as shown on Figs. 2 and 3, while those representing elements and radicals with negative (—) electrons may be colored red as shown on Figs. 2 and 3. The block 18 is of deeper blue color than block 42. This affords a method of grading the elements according to their basic powers, the stronger basic elements being preferably of darker shade than the weaker elements or radicals. In like manner the valence block 30 is of darker red color than the valence block 58 thus denoting a radical or element of stronger acidity. By properly grading the shades of blue and red, I afford a means for ready comparison of the elements and radicals according to their powers as bases and acids.

The color scheme may also be applied to my valence blocks employed for elements having two or more different valences and possessing positive (+) electrons in some instances and negative (—) electrons at other times. Referring to Fig. 9, it will be seen that the half of the diamond-shaped body having the wedge-shaped ends projecting from the sides is colored blue

while the half of the diamond-shaped body having the grooved ends projecting from the sides is colored red.

If desired, legendary characters and words may be applied to my valence blocks to show the number of (+) or (—) ions or electrons, the signs of the electrons or ions, the chemical symbol, the chemical formula, the valence, the atomic weight of the elements and radicals, etc.

My novel valence blocks afford a very effective means for instruction of students and other persons possessing the faculty of sight and are also adapted for the blind. These valence blocks are also adapted for affording entertainment and amusement.

As a further aid to blind students, the basic and acid strengths of the elements and radicals designated by the blocks, may be demonstrated by varying the weights of the blocks. For example, the more active the element or radical, the heavier the valence block.

The present invention is not limited to the specific details set forth in the foregoing examples which should be construed as illustrative and not by way of limitation, and in view of the numerous modifications which may be effected therein without departing from the spirit and scope of this invention, it is desired that only such limitations be imposed as are indicated in the appended claims.

I claim as my invention:

1. Means for illustrating chemical reactions comprising blocks appropriately designated to represent chemical elements and radicals, said blocks having projecting arms corresponding in number to the valence of the particular elements and radicals represented by such blocks, the extremities of the arms on the blocks representing positive elements and radicals having a characteristic configuration and the extremities of the arms on the blocks representing negative elements and radicals having another characteristic configuration adapted to mate with the extremities of the arms on the blocks designating the positive elements and radicals.

2. Means for illustrating chemical reactions comprising blocks having, each, a characteristic configuration appropriately designated to represent positive chemical elements and radicals and blocks of another characteristic configuration appropriately designated to represent negative chemical elements and radicals, said blocks having projecting arms corresponding in number to the valence of the particular elements and radicals represented by such blocks, the extremities of the arms on the blocks representing elements and radicals of ions of one sign having protuberances and the extremities of the arms on the blocks representing elements and radicals of ions of the opposite sign being recessed to receive and mate with said protuberances.

3. Means for illustrating chemical reactions comprising blocks having, each, a characteristic configuration appropriately designated to represent positive chemical elements and radicals and blocks of another characteristic configuration appropriately designated to represent negative chemical elements and radicals, said blocks having projecting arms corresponding in number to the valence of the particular elements and radicals represented by such blocks, the extremities of the arms on the blocks representing elements and radicals of ions of one sign having tongues and the extremities of the arms on the blocks representing elements and radicals of ions of the opposite sign being grooved to receive and mate with said tongues.

4. Means for illustrating chemical reactions comprising blocks having, each, a characteristic configuration and color appropriately designated to represent positive chemical elements and radicals and blocks of another characteristic configuration and color appropriately designated to represent negative chemical elements and radicals, said blocks having projecting arms corresponding in number to the valence of the particular elements and radicals represented by such blocks, the extremities of the arms on the blocks representing elements and radicals of ions of one sign having tongues and the extremities of the arms on the blocks representing elements and radicals of ions of the opposite sign being grooved to receive and mate with said tongues.

5. Means for illustrating chemical reactions comprising blocks having, each, a characteristic configuration and color appropriately designated to represent positive chemical elements and radicals and blocks of another characteristic configuration and color appropriately designated to represent negative chemical elements and radicals, the intensity of coloration of said blocks being in variation with the basic and acid powers of the represented chemical elements and radicals, and said blocks having projecting arms corresponding in number to the valence of the particular elements and radicals represented by such blocks, the extremities of the arms on the blocks representing elements and radicals of ions of one sign having protuberances and the extremities of the arms on the blocks representing elements and radicals of ions of the opposite sign being recessed to receive and mate with said protuberances.

6. Means for illustrating chemical reactions comprising blocks having, each, a characteristic configuration and color appropriately designated to represent positive chemical elements and radicals and blocks of another characteristic configuration and color appropriately designated to represent negative chemical elements and radicals, the intensity of coloration of said blocks being in direct variation with the basic and acid powers of the represented chemical elements and radicals, and said blocks having projecting arms corresponding in number to the valence of the particular elements and radicals represented by such blocks, the extremities of the arms on the blocks representing elements and radicals of ions of one sign having protuberances and the extremities of the arms on the blocks representing elements and radicals of ions of the opposite sign being recessed to receive and mate with said protuberances.

7. Means for illustrating chemical reactions comprising blocks having, each, a characteristic configuration and blue color appropriately designated to represent positive chemical elements and radicals and blocks of another characteristic configuration and red color appropriately designated to represent negative chemical elements and radicals, the intensity of coloration of said blocks being in direct variation with the basic and acid powers of the represented chemical elements and radicals, and said blocks having projecting arms corresponding in number to the valence of the particular elements and radicals represented by such blocks, the extremities of the arms on the blocks representing elements and radicals of ions of one sign having protuberances and the extremities of the arms on the blocks representing

elements and radicals of ions of the opposite sign being recessed to receive and mate with said protuberances.

8. Means for illustrating chemical reactions comprising blocks having, each, a characteristic configuration appropriately designated to represent positive chemical elements and radicals and blocks of another characteristic configuration appropriately designated to represent negative chemical elements and radicals, said blocks having projecting arms corresponding in number to the valence of the particular elements and radicals represented by such blocks, the extremities of the arms on the blocks representing elements and radicals of ions of one sign having protuberances and the extremities of the arms on the blocks representing elements and radicals of ions of the opposite sign being recessed to receive and mate with said protuberances, and the spacing between the arms on blocks having a plurality of arms being equal.

9. Means for illustrating chemical reactions comprising blocks having, each, a characteristic configuration appropriately designated to represent positive chemical elements and radicals and blocks of another characteristic configuration appropriately designated to represent negative chemical elements and radicals, said blocks having projecting arms corresponding in number to the valence of the particular elements and radicals represented by such blocks, the extremities of the arms on the blocks representing elements and radicals of ions of one sign having protuberances and the extremities of the arms on the blocks representing elements and radicals of ions of the opposite sign being recessed to receive and mate with said protuberances, and said blocks having point print for tactual reading by the blind.

10. Means for illustrating chemical reactions comprising blocks having, each, a characteristic configuration appropriately designated to represent positive chemical elements and radicals and blocks of another characteristic configuration appropriately designated to represent negative chemical elements and radicals, said blocks having projecting arms corresponding in number to the valence of the particular elements and radicals represented by such blocks, the extremities of the arms on the blocks representing elements and radicals of ions of one sign having protuberances and the extremities of the arms on the blocks representing elements and radicals of ions of the opposite sign being recessed to receive and mate with said protuberances, said blocks having point print for tactual reading by the blind and the weights of said blocks being in variations with the basic and acid powers of the represented chemical elements and radicals.

11. Means for illustrating chemical reactions comprising blocks appropriately designated to represent chemical elements which react amphoterically, said blocks containing two sections, one of said sections having projecting arms corresponding in number to the valence of the particular element represented by such block when reacting positively and the other section of the block having projecting arms corresponding in number to the valence of the particular element represented by such block when reacting negatively, the extremities of the arms on one of said sections of the block having a characteristic configuration and the extremities of the arms on the other section of the block having another characteristic configuration adapted to mate with the extremities of the first named characteristic configuration.

12. Means for illustrating chemical reactions comprising blocks appropriately designated to represent chemical elements which react amphoterically, said blocks containing two sections of characteristically different coloration, one of said sections having projecting arms corresponding in number to the valence of the particular element represented by such block when reacting positively and the other section of the block having projecting arms corresponding in number to the valence of the particular element represented by such block when reacting negatively, the extremities of the arms on one of said sections of the block having a characteristic configuration and the extremities of the arms on the other section of the block having another characteristic configuration adapted to mate with the extremities of the first named characteristic configuration.

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