July 1, 1952 J. B. UNDERWOOD 2,601,729

ATOMIC MODEL MACHINE

Filed Sept. 7, 1948 2 SHEETS—SHEET 1

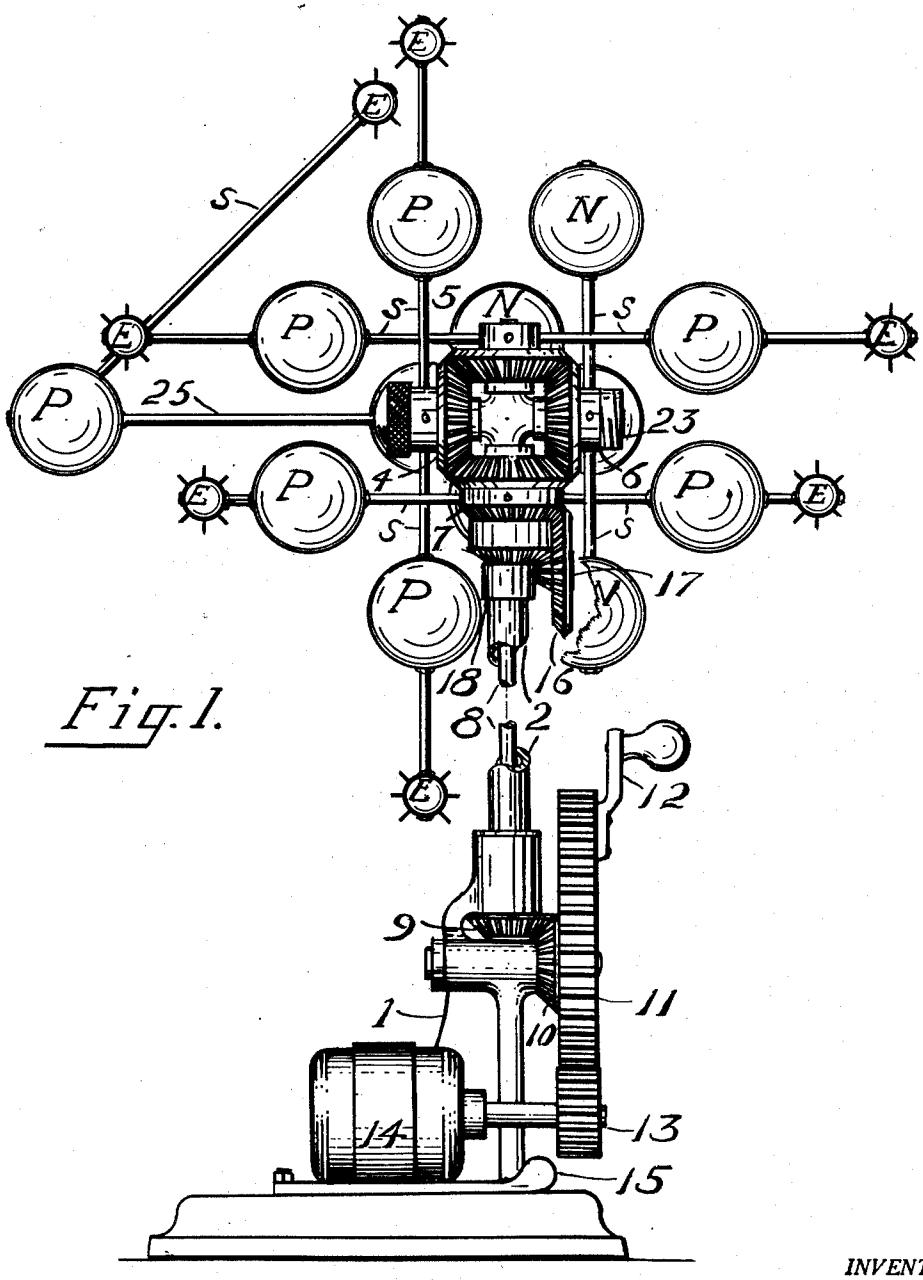

Fig. 1.

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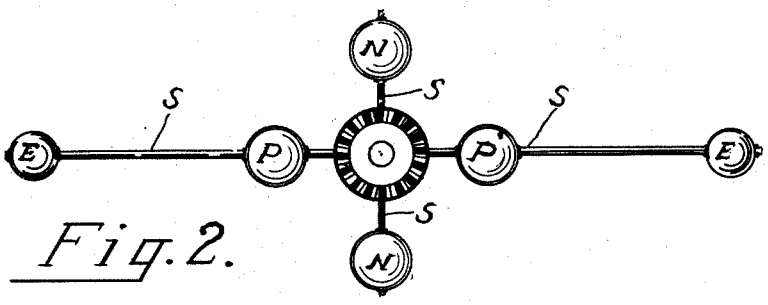

Fig. 2.

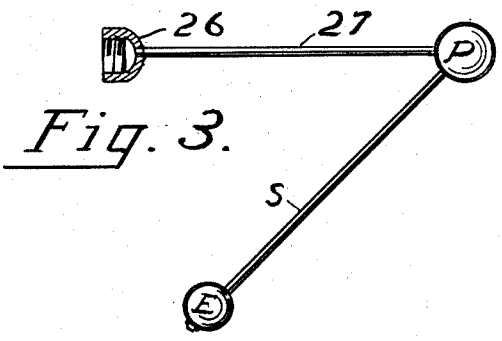

Fig. 3.

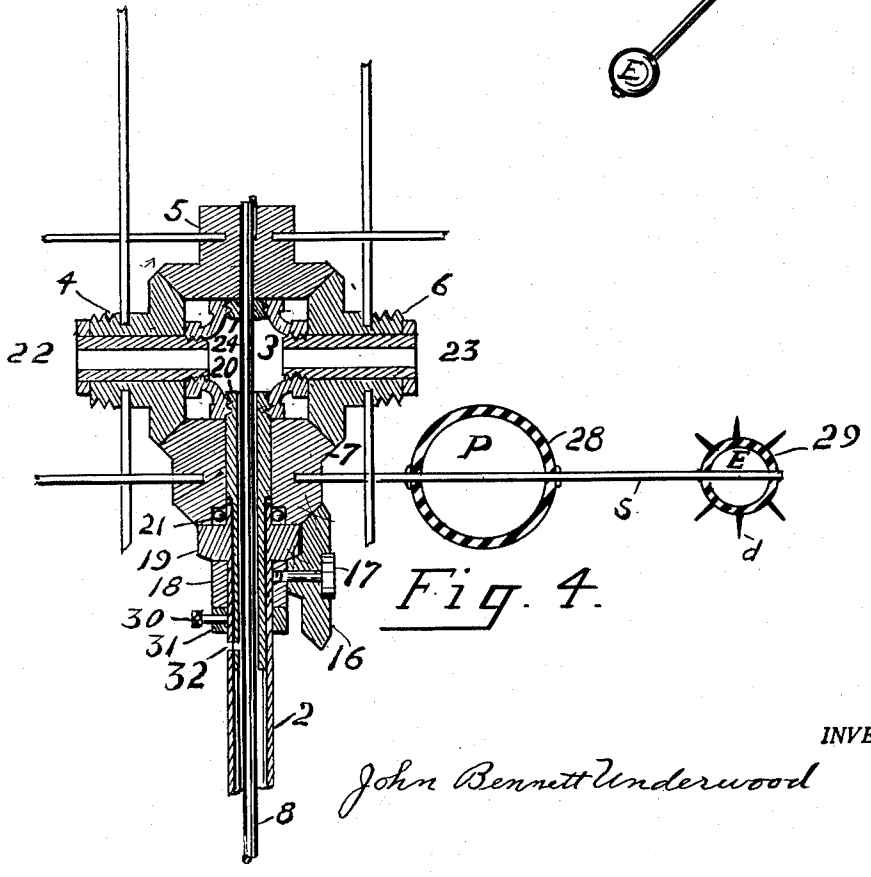

Fig. 4.

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ATOMIC MODEL MACHINE

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2 Claims. (Cl. 35—18)

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My invention relates to improvements in atomic models in which balls representing atomic particles are caused to move in circular orbits within or about a central nucleus simulating the supposed movement of particles within the actual atom. The object of my invention is to demonstrate the motion of the particles composing the atom in a manner similar to that of a planetarium in showing the movement of planets about the sun.

Before proceeding with the description of my invention, I wish to state some tenets of the atomic theory it is intended to portray. According to the Bohr theory, the atom is made up of a central nucleus of protons and neutrons which mill about in a limited space and which are held in place by nuclear forces not fully understood. About this nucleus in eliptical or circular orbits, revolve electrons, or negative particles of electricity, which are held in their orbits by equal positive charges of protons within the nucleus. Evidence of atomic magnetic effects, indicate that the protons, neutrons, and electrons, as well as the entire nucleus, each have a spin motion. Properties of atomic weights depend principally upon the number of protons and neutrons within the nucleus of the atom, the weights of the electrons being negligible. Chemical properties and emission of radiant energy depend upon the electrons. Chemical valence is due to electrons in the outer or valence orbit of the atom. Finally, most scientists think of electrons as consisting of cloud layers rather than particles. The mass of the electron increases with its velocity. Without restricting the scope of my invention to the validity of all the points mentioned in the theory as herein stated, it is the object of my invention to demonstrate mechanically this conception of the atom.

The model used in the following description is that of the oxygen atom, which has eight protons and eight neutrons within its nucleus, and eight electrons in its planetary orbits, two of which are in the inner or *k* orbit, the remaining six being in the outer *l*, or valence orbit. Two hydrogen atoms, each having one proton and one electron, are shown for the purpose of demonstrating the water molecule. The machine may be adapted for use in demonstrating other elements or compounds.

I attain these objects by mechanism illustrated in the accompanying drawings in which—

Figure 1 is a vertical view of the entire machine with its supporting standpipe broken near the middle; Fig. 2, a plan view of one of the lateral

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miter gear assemblies; Fig. 3, a plan view of an attachable hydrogen atom assembly; and Fig. 4, a vertical section of the head of the machine on a line through the center parallel to the plane of the drawing sheet.

The balls representing atomic particles are lettered N, P, and E, meaning neutron, proton, and electron, respectively. The spokes carrying these balls are labelled *s*, and the darts hereinafter mentioned, *d*. All other parts are represented by numerals which refer to similar parts throughout the several views.

The pedestal or supporting base 1 and vertical pipe 2, shown broken near its middle, constitute the framework of the machine. (See Fig. 1.) At the upper end of pipe 2 is mounted the head, consisting of cross-T 3, carrying miter gear assemblies 4, 5, 6, and 7. Vertical shaft 8 to which is secured miter gear 9 at its lower end, extends up inside pipe 2, and through cross-T 3, to miter gear 5, which is also secured thereto. At the lower end of shaft 8, miter gear 9 engages miter gear 10, which is secured to the hub or spur wheel 11, to which is attached crank 12. Spur wheel 11 may be driven by pinion 13, secured to the shaft of motor 14, as shown, when lever 15, which is secured to the base of motor 14, is moved in shifting the position of said motor 14, until pinion 13 engages spur wheel 11. Thus, spur wheel 11 may be caused to rotate by use of either motor 14 or crank 12. Pipe 20, to which is secured cross-T 3, as shown in Fig. 4, is fitting closely and making a long bearing in and with collar 19, so that the head can rotate only when forced by the pinion hub of gear 16, under the leverage of the teeth of the larger circumference of said gear 16. Gear 7 can turn much easier on ball bearings 21. When shaft 8 is caused to rotate as described, miter gear 5 drives miter gears 4, 6, and 7, which are engaged in the system, causing the four gears to rotate in unison.

On the lower face of miter gear 7 are cut teeth which engage gear wheel 16, carried by axle 17, which is secured to collar 18, free to turn on pipe 2, as shown. On the hub of gear wheel 16 are teeth which engage teeth on the lower end of collar 19, which is secured to, or really a part of pipe 2.

Details of the head are best shown in the cross section, Fig. 4. Pipes 2 and 20 serve as a common axle for miter gear 7, at the lower end of which is a circular groove retaining ball bearings 21, which carry the weight of the entire head, as shown. Pipes 22 and 23, which are screwed into cross-T 3, are axle for miter gears 4 and 6. Miter

gear 5, secured to shaft 8, which turns in bearing 24, screwed into cross-T 3, is the driver. As the four miter gears 4, 5, 6, and 7, rotate in unison, bevel gear 16 is caused to rotate, and since the teeth on the hub of said bevel gear 16 engage the teeth on collar 19, and since further, axle 17, which carries bevel gear 16, is secured to movable collar 18, the entire head will rotate on pipe 2, but at a slower speed than miter gears 4, 5, 6, and 7.

I have referred to miter gears 4, 5, 6, and 7, meaning not only the miter gear itself, but the attached spokes carrying the balls representing the atomic particles. Protons P and electrons E are carried on spokes, common to both, as shown in plan view Fig. 2 of one of the miter gear assemblies removed. This feature illustrates the mutual and equal attraction of the negative electron for the positive proton. The spokes which carry neutrons N, which have no charge, terminate with the balls N. Each of the balls N, P, and E is free to rotate on its spoke axis. This feature is intended to portray the magnetic effects of these particles according to the theory already described. The objects used to represent particles N, P, and E are preferably hollow rubber balls 28 and 29, best shown on spoke *s*, cross section, Fig. 4. The electron particles E, have flexible darts *d*, projecting therefrom. Thus, in rotating on their axis or revolving in their circular orbits, they have the appearance of increased size, which for the purpose of demonstration, may simulate increased mass, illustrating the theory that the mass of the electron increases with its velocity.

While particles N, P, and E are to be given distinguishable colors in actual construction of the machine, it is not deemed necessary to try to illustrate this feature in the drawings.

When the machine is in operation, the motion of the various balls in their circular orbits, produce the illusion of a large spherical mass or blur, giving the appearance of a single mass, having a distinguishable nucleus, which is quite in conformity with the theory the machine is intended to illustrate.

In Fig. 1, some of the nuclear particles are omitted from in front of the head in order to better expose the gears. It will be noticed that in the lower gear assembly 7, the spokes *s* are shorter than those of the other gear assemblies. (See Fig. 1.) This provides for representing the inner or *k* orbit and the outer or *l* orbit for the two electron shells.

In accordance with chemical theory that the valence of a chemical element depends upon the nearness to completion of the outer valence orbit of the atom to a maximum saturation of eight in the case of oxygen, this atomic model lacks two electrons of completing its outer orbit, and hence has a negative valence of two. Hydrogen, with only one electron, has a positive valence of

one. This brings us to Fig. 3, and also to 25 of Fig. 1, and explains the use of the threads on the hubs of miter gears 4 and 6. The hydrogen assembly, Fig. 3, having shaft 27, secured to screw cap 26, may be attached to the screw hub of miter gear 6, Fig. 1, in the manner shown by a similar hydrogen assembly 25, which is shown secured to the hub of miter gear 4. Thus, the two electrons from the two hydrogen atoms, fill the incomplete valence orbit of the oxygen atom and form a model of the water molecule H_2O. The machine may now be operated as before, but more slowly.

At this point it may be desired that the head be prevented from rotating, permitting only the four miter gear assemblies 4, 5, 6, and 7 to rotate. To accomplish this, screw 30, Fig. 4, may be loosened, allowing collar 18, which carries axle 17 and bevel gear 16, to slide down on pipe 2, until screw 30 aligns with hole 32, common to pipes 2 and 20, thus securing the two pipes 2 and 20, as one, and carrying bevel gear 16 out of contact with gear wheel 7. In this adjustment only the miter gears 4, 5, 6, and 7 are free to rotate, miter gear 5, being the driver.

I am aware that prior to my invention atomic models have been made. I am also aware that planetariums to represent the movement of heavenly bodies have long been made. I therefore do not claim such broadly but I claim:

1. In a dynamic atomic model machine of the character described, a standpipe support mounted on a pedestal and housing a drive shaft, a cross-tree secured at the top of said standpipe and providing axle for miter gears and a means of driving them, a miter gear assembly having four spokes upon two of which are mounted terminally, balls representing neutrons, and upon two of which are mounted balls representing protons but carrying also other balls terminally and representing electrons.

2. In a dynamic atomic model machine, projecting spokes attached to miter gears mounted on axle at the head of a standpipe housing a drive shaft driven from a supporting pedestal, each spoke carrying balls representing atomic particles, said balls being free to rotate to illustrate the magnetic effect said to be the result of actual rotation of atomic particles.

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