and the increase of pressure. Professor Faraday, however in a series of magnificent experiments, proved that such a distinction had no foundation whatever. He not only liquefied but solidified many gases that had been deemed permanently elastic, and these experiments have been repeated and extended by other investigators, until the belief now obtains that no particular state, whether solid, liquid, or gaseous, is specific to any kind of matter, and that these states depend solely on the relations of the molecules of bodies to heat.

The converse of these experiments, that is, the changing of solids and liquids to a gaseous state, has been performed with nearly every known solid or liquid, and the colors which these gases impart to the blow-pipe flame, and the colors and positions of the peculiar lines or bars, formed by passing the light of such colored flames through a prism, and throwing the beam of refracted light upon a screen, have been found to indicate the nature of different substances with the utmost delicacy. This method of determining the presence of substances by the examination of the effect which the presence of their vapors produces upon the light emitted by burning alcohol, gas, solar light, etc., is called spectrum analysis; and the instrument employed in making such researches is called the spectroscope.

An entirely new department of chemistry has grown out of the extension of the use of the spectroscope to the examination of the light emitted by the heavenly bodies, and such examinations have led to the belief that the elementary substances as we know them by close examination in the chemical laboratory, are distributed throughout the universe.

One of the most prominent physical characteristics of gases, is their great elasticity. It is this property upon which the usefulness of steam as a motive power in a very great measure depends. In fact, gases and non-viscous liquids are the only perfectly elastic bodies.

The theory of the elasticity of gases is comprised in what is known as *Mariotte's Law*, which is "that in an elastic fluid subjected to compression, and kept at a constant temperature, the product of the pressure and the volume is a constant quantity;" or, in other words, the volume is inversely proportional to the pressure. This law does not, however, hold good for all pressures, nor for all gases. In those most difficult to liquefy, as oxygen, nitrogen, or their mixture in atmospheric air, etc., the law holds good, but in such gases as chlorine, steam, and others that can be liquefied under such pressure as can be practically brought to bear upon them, departures from the law are observable, increasing as the gases approach liquefaction. Such variations are, however, of little practical importance, and the law as enunciated is sufficient for all ordinary purposes of computation.

Another prominent characteristic of gaseous bodies is their affinity for water. Water absorbs all gases to a greater or less degree. The colder the water and the greater the pressure the more gas will be absorbed, and *vice versa*; but the volumes of different gases which water and other liquids will absorb, vary greatly. Gases are also absorbable by solids to a large extent, wood charcoal and animal charcoal being some of the most powerful solid absorbents.

But perhaps the most remarkable property of gases is that which gives rise to what is called diffusion. The heaviest gases when placed in contact with the lightest, do not remain separate like oil and water, but mingle and diffuse each through the other in defiance of gravity. This even takes place when the gases are separated by a porous diaphragm. A common experiment, illustrating this truth, is to fill a glass jar with carbonic acid and invert over it a jar filled with hydrogen, which is twenty-two times lighter than carbonic acid. In a very short time equal quantities of both gases will be found in each jar. This has led to the enunciation of the law that every gas comports itself toward every other gas as though it were a vacuum. Thus the presence of dry air in a vessel does not prevent, though it will somewhat retard the entrance of any other gas. As much of the latter will enter with the air present as would be the case if the air were exhausted.

Regnault was the first to prove that although the expansion of each gas is nearly equal for equal increments of heat when rising from different temperatures, all gases do not expand alike for a given increase of heat. We have said the expansion of each gas is nearly equal for equal increments of heat. For practical purposes this expansion may be considered as absolutely equal, as the differences are but slight, and only determinable by accurate experiment. The most important application of this law of expansion, is made in the steam engine, when steam is used expansively.

The distinction between vapors and gases has been, as we have said, virtually abandoned; but the term vapor is still commonly applied to such gases as are most readily reduced to the liquid state. Though it may seem to some an innovation to talk of steam as a gas, yet it is a gas, possessing the physical characteristics of all other gases, and must be considered as such to attain a perfect comprehension of its action as a motive power.

NEW MECHANICAL MOVEMENTS.

Perhaps no department of study is more improving to the inventive faculty than the study of mechanical movements—those minor machines which, combined, produce the various motions to be found in complicated machinery.

The mechanical powers, as they are called—*i.e.*, the lever, the inclined plane, the wedge, the screw, the wheel and axle, and the flexible band or rope—may properly be reduced to three—the lever, the inclined plane, and the band. For the wedge and screw are only modifications of the inclined plane, while the wheel and axle is a modification of the lever.

These three fundamental elements are therefore the basis of all mechanical movements, that is, combinations to produce certain movements of parts of machines. There are already a great number of these in use, and a still larger number which have never been much used, but there is little doubt that there are a great many more which are possible. The search for these gives rise to some of the most beautiful mechanical problems, as well as some of the most difficult. The solution of one of these was given on page 372, Vol. XVIII.

We propose now to enunciate a few such problems upon which our inventors may try their skill, premising that, as in the higher mathematics, the solution of a problem demonstrates its impossibility if it be impossible; so, if it can be satisfactorily shown that the problems here given are any of them impossible, that shall be considered as a proper solution.

Problem 1.—Required to convert the rotary motion of a pulley into a horizontal intermittent rectilinear motion, first in one direction and then in the opposite direction, without the use of a pitman, pulley, toothed wheel, cam, cam groove in a pulley, or a flexible band, the first rotary motion to be constant and uniform. In other words, let it be required to move a piece of metal, wood, or other material, to a certain point where it shall pause, and then again move on a certain distance and again pause, and so on successively as far as desired, when it shall return to the point from which it originally started in the same intermittent manner and under the conditions above specified.

Problem 2.—Required to produce a variable rotary motion in a shaft driven directly by a belt from a pulley having a uniform constant rotary motion, without the use of anything but the one belt and the two pulleys; no cone pulleys or their equivalent to be allowed. All the motions to be continuous and in the same direction.

Problem 3.—From a reciprocating body to communicate reciprocation to another body, so that the second shall make four reciprocating movements for every reciprocation of the first; the motions of these bodies to be in lines parallel to each other, and the pieces to be connected by only three moving parts, which parts shall be neither wheels nor pulleys of any kind, and no inclined planes, cams, belts, or flexible cords, cranks, or bell cranks, to be allowed, and no radial motion from a fixed center in any piece employed.

This will do for the present. Some of these problems are, perhaps, too difficult for a beginning, but they are all capable of solution. It is not at all improbable that the effort to solve them will lead to some useful inventions. The author of them made two useful applications of ideas suggested while attempting their solution.

The solutions offered may be given in simple diagrams accompanied with such description as may be necessary.

PROPOSED PLAN FOR PUBLISHING PATENT OFFICE SPECIFICATIONS AND DRAWINGS.

The speech of Mr. Jenckes, of Rhode Island, in the House of Representatives, on the 9th inst., in support of the House joint resolution providing for the publication of the specifications and drawings of the Patent Office, and the subsequent debate upon the subject, has placed the salient features of the plan in such a light that the public generally may comprehend its advantages.

It is proposed to abandon the publication and distribution of the annual reports as they are now published, and instead to place in the capital of every State, and in every city where a circuit Court of the United States is held, if it be not held in the capital, a complete record of the transactions of the Patent Office; the specifications in full and the drawings in full. Then the inventor has simply to take rail or boat, and visit the capital of his State, and he will have the same means of investigating what are the inventions of the country as if he came to Washington in person.

It is also proposed to furnish an equally perfect record to each public library in any part of the United States, which shall pay for its uniform binding and its transportation to the locality where the library is situated.

It is further intended to make this distribution weekly, so that the latest information relative to patents may be accessible to the entire country.

The disadvantages of the present system are great. It is confessedly expensive, incomplete, inaccurate, and inadequate to meet the needs of inventors.

The advantages of the new system are as obvious as the disadvantages of the old. The distribution being not a matter of favor, as now, the filed drawings and specifications will form a complete as well as an accurate and reliable record. Under the present system the distribution is very imperfect, so much so that complete sets of the reports since their publication in 1844, are rare outside of Government Departments, though not so much so as to justify Mr. Banks' statement in the debate referred to. Mr. Banks said that "Of all the million volumes that have been distributed, I do not believe that there is within the United States in the hands of any private citizen, unless he have some special Government advantages, a complete set of this encyclopedia of inventions. The chairman of the Committee on Printing tells me that there is not in the Patent Office itself, nor in the Library of Congress even, a complete set; and I do not believe that such a set exists in any one of the one hundred and four principal public libraries of the United States, which contain ten thousand volumes and upward. Now what a senseless practice is the distribution of this work, at a cost of $235,000 a year, when the value of it is greatly impaired by the manner in which it is distributed."

We have a complete set of these reports, and they are of great service to us. They are constantly sought by large numbers of persons interested, who daily visit our office to cousult them. It is true, however, that only complete sets are of much assistance, and that the drawings are often so defective in their lettering as to mislead; and they are altogether too meager to give such information as will form a basis for accurate judgment.

It is claimed that the new system will decrease the expenses of the Patent Office for printing $100,000 per annum, and it will also reduce the expenses of those who now have to go to Washington to pursue their investigations by requiring them only to journey a short distance to obtain the necessary information.

It is thought this plan would increase the confidence of capitalists and make them more ready to invest in really new and useful inventions, as they would easily be able to verify the value of an invention, so far as novelty is an element of value.

By means of the art of photo-lithography the drawings can be reproduced of half the present regulation size at an estimated cost of one dollar and fifty cents per hundred, and although the bill, in its present form, provides only for the publication of specifications and drawings after the publication of the report of 1868, it is estimated that all the drawings and specifications issued prior to 1870 might be reproduced is 300 volumes at a cost of $200,000.

Mr. Jenckes performed an act of injustice in his speech toward honest and honorable patent solicitors, in making no distinction between them and such as do not identify themselves with the interests of their clients. No one knows better than Mr. Jenckes that this is unjust, and it is probable that his zeal in the support of his measure, betrayed him into an unguarded expression.

We heartily advocate the passage of this resolution; but we would have the plan extended to the publication of the specifications and drawings of all the patents which have been issued up to the present date; and it ought also to be amended so as to admit of the purchase at cost by such parties as are willing to pay for it in advance of publication. Many copies could thus be sold without increasing the cost to the Government, and a much wider circulation be given to them.

CONGRESS EXTENDING PATENTS.

In the House of Representatives on Friday, March 11, the following measures concerning patents were enacted:

Reports were made from the Committee on Patents by Mr. Jenckes adversely on the following applications:

For extension of patents of J. Carhart, of New York, and of Charles A. Pitcher, for the manufacture of brooms.

Bills were reported from the same committee allowing applications for the extension of patents as follows:

By Mr. Jenckes—Patent of Walter Hunt for the manufacture of paper collars. Passed.

By Mr. Calkin—Patent of Timothy D. Jackson for improved annunciator or bell-telegraph for hotels, etc. Passed.

By Mr. Myers—Patent of Thomas Thompson for improved machine for folding paper. Passed.

Also, patent of William Montstown for improvement in revolving fire-arms. Passed.

Also, patent of John Edgar for self-regulating wind wheels. Passed.

Also, patent of Tobias J. Kindleberger for improvement in cider mills. Passed.

By Mr. Calkin—Patent of John Young for improved washing and wringing machine. Passed.

By Mr. Johnson—Patent of Jonathan Haines, for harveste or header.

After discussion by Messrs. Johnson and Cullom in suppo of the bill, and by Mr. Tanner in opposition to it, the bill w passed.

By Mr. Jenckes—Patent of Augustus R. Moen for improvement in the construction of basement, cellar, conduit, and other like walls, so as to render them impervious to water. Passed.

Also, patent of Robert Burns Goodyear for improvement in power looms.

Pending its consideration the morning hour expired, and the bill went over to the morning hour next Friday.

If this kind of special legislation by Congress is to continue, the statues relating to extension of patents might as well be repealed. Of what use is it to absorb the time of the Commissioner, who knows what he is about, in the examination of applications for extension, when a successful appeal from his decision can be made to Congress through the aid of expert lobbymen, thus practically taking the power of granting or refusing extensions out of the Commissioner's hands? We have always opposed this sort of legislation.

To Clean Paint.—There is a very simple method to clean paint that has become dirty, and, if our housewives should adopt it, it would save them a great deal of trouble. Provide a plate with some of the best whiting to be had, and have ready some clean warm water and a piece of flannel, which dip into the water and squeeze nearly dry; then take as much whiting as will adhere to it, apply it to the painted surface, when a little rubbing will instantly remove any dirt or grease. After which wash the part well with clean water, rubbing it dry with a soft chamois. Paint thus cleaned looks as well as when first laid on, without any injury to the most delicate colors. It is far better than using soap, and does not require more than half the time and labor.

Picture frames or frames for loooking-glasses may be easily coated with bronze by a thin plate of liquid quartz upon which a fine bronze powder is dusted.