to run an air compressor, given the following: The internal dimensions of the cylinder, the speed, and the maximum internal pressure, or the pressure at which the air is delivered from the compressor. A. The horse-power required to run an air compressor, neglecting friction, equals the area of the cylinder in square inches multiplied by the internal pressure per square inch, multiplied by the number of feet which the piston moves per minute, and the whole divided by 33,000. Taking friction into account, the power necessary would be nearly double this amount. 2. In finding the exact horse-power required, would the external pressure be considered? A. In determining the exact horse-power, the difference in pressure of the two sides of the piston in pounds per square inch is the figure that should be used. 3. Of what advantage is a several-staged compressor over a single-staged one? A. A several-staged compressor has the following advantages: The air is compressed less in each cylinder, and therefore a larger amount of air can be forced out of each cylinder per stroke. The valves work more satisfactorily, and there is less leakage, because the difference in pressure on the two sides is less. Second, a small amount of leakage does less harm. The increase in temperature due to the compression in each cylinder is less, and the air may be cooled between the various stages of the compression. The work is more uniformly distributed throughout the entire stroke, making the compressor run more smoothly. 4. What would be the formula for finding the horse-power required for a two, three, or four stage compressor? A. The horse-power of the two, three, or four stage compressor is found by first finding the horse-power of each cylinder, by the method already explained, and adding these amounts together. 5. Is there a formula for computing the horse-power of a steam turbine, given the steam or air pressure and the number of cubic feet of steam or air delivered per minute at a given pressure? At what pressure will a turbine work most economically? Does a turbine generate as much power with a given amount of steam as a reciprocating engine? A. There is no reliable formula for computing the horse-power of the steam turbine. In general, steam turbines will develop about the same horse-power for a given amount of steam as reciprocating engines. A small power turbine at 120 pounds steam pressure non-condensing, will require 40 or 45 pounds of steam per horse-power per minute. On the other hand, a larger turbine, designed so as to get the full benefit of the expansion of the steam, when working with steam at 180 pounds pressure and condensing, may be operated with about 16 or 18 pounds of steam per horse-power per hour. The higher the steam pressure, the more economical will be the turbine.

(10569) W. M. says: I wish to experiment with compressed air, and desire a little information on that subject. Air compressed to a density of 50 pounds to the square inch and admitted to a cylinder 3 inches in diameter for a distance of 2 inches, how far will the piston travel before losing all its expansive force? Also, at 100 and 200 pounds to the square inch? A. When air expands, its *absolute pressure* decreases in the same proportion that its volume increases, so long as the temperature remains constant. The absolute pressure is found by adding 15 pounds—the atmospheric pressure—to the pressure which is shown by the gage. Thus, if one cubic foot of air at 50 pounds pressure expands to two cubic feet, the absolute pressure after expansion will be $50+15\div2=32.5$. This equals a pressure of $32.5-15=17.5$ pounds above the atmosphere. In the same way, if the volume were increased to 3 cubic feet, the final pressure would be $50+15\div3=21.6$. This equals a pressure of 6.6 pounds above the atmosphere. This rule can be applied to any pressure and to any change in volume, so long as the temperature remains constant. The rule does not exactly apply to compressed air in the cylinder, because the temperature of the air decreases when the air expands, and this decrease in temperature decreases the pressure somewhat by the figures given by the above rule. Where the expansion is not carried too far, however, the above rule gives results which are approximately correct. If the fall in temperature is known, the final pressure, as determined by the above rule, may be corrected by multiplying it by the following formula: $\frac{460+t1}{460+t2}$ where $t1$ equals the temperature of the air in degrees Fahrenheit at the end of the expansion, and $t2$ equals the temperature of the air in degrees Fahrenheit at the beginning of the expansion.

(10570) W. T. H. asks: Can you tell me if there is any machine invented or patented (or in use) to produce power by any of what are called the mechanical powers, such as the wedge, the screw or lever, as a motor solely without any other agent whatever, such as air, water, electricity, heat in any form or chemicals; simply a mechanical motor to drive or operate machinery? I do not mean the perpetual motion fiend business, but something to push and pull with for something. A. We do not know of any motor as a generator of power such as you call for, but a lever or any other of the mechanical powers, by the aid of a weight, acting under gravity, will generate power and comes within the limits of your question. They do not use air, water, heat, electricity, or chemicals, but only gravity. They may drive machinery also, but the weight will have to be wound up again after it has run down to its limit. A clock is a machine so driven, and comes well within your requirements. Nor is it a perpetual motion machine.

(10571) C. S. asks: At what pressure does acetylene gas begin to liquefy, and what chemical can be used to purify it so that a pressure of 200 pounds can be used safely? A. The critical pressure of acetylene is 750 pounds. The critical temperature is quite high, so that it will liquefy in the tank by compression. The tanks contain asbestos disks which are saturated with acetone.

(10572) H. C. D writes: In a quotation from the Chemical News, in your issue of May 25, there is a statement that the temperature of dissociation of water is probably about 2,500 deg. C. Water decomposes at a temperature less than that of melting platinum. Following Holleman's "Inorganic Chemistry," I used a liter flask having a stopper and delivery tube. Through the stopper extended two copper wires. Connecting these just above the water was a coil of No. 26 platinum wire. A 110-volt current was used with a rheostat giving varying resistance. With the rheostat set to deliver about 14 amperes the wire melted. With it set to deliver 12 amperes I was able to collect a mixture of hydrogen and oxygen, shown by its explosiveness. The current actually used was not measured. The water was boiling during the experiment. T he melting point of platinum is usually given as 2,000 deg. C., which would make the decomposition temperature of water something less than 2,000 deg. C. A. It is quite true that water begins to be dissociated at a temperature considerably below that of the melting point of platinum, but the process is not completed till considerably above the melting point of platinum. It is commonly taken to begin at 1,200 deg. C. and to be complete at 2,500 deg. C. Dissociation does not take place suddenly, but gradually. The melting point of platinum is given variously by different authorities. The Smithsonian tables give from 1,775 deg. to 2,200 deg. Baker & Co., the large workers in platinum, give the lower figure. A mean figure is 1,900 deg. Had the Chemical News stated the temperature of *complete* dissociation to be 2,500 deg. it would have been more correct.

(10573) M. S. T. asks: Kindly let me know what liquid will expand and contract the most and easiest. A. Ether expands most for a change of temperature of any liquid for which we have data, and acetone is next in the list. Benzene has the lowest specific heat of any liquid for which we have data, and hence will expand easiest.

NEW BOOKS, ETC.

THE VOICE OF THE MACHINES. An Introduction to the Twentieth Century. By Gerald Stanley Lee. Northampton, Mass.: The Mount Tom Press. 12mo.; cloth; 190 pages. Price, $1.25.

A number of more or less rhapsodical essays on the spiritual side of machinery. They mark the passing of the "poet of uselessness," and the advent of the poet who can see beauty in mechanical perfection.

BEAN CULTURE. By Glenn C. Sevey. New York: Orange Judd Co. 16mo.; cloth; 130 pages; illustrated. Price, 50 cents.

A practical treatise on the production and marketing of beans. It includes the manner of growth, soils and fertilizers, best varieties, seed selection and breeding, planting, harvesting, insects and fungous pests, composition and food value; with a special chapter on markets by Albert W. Fulton. A practical book for the grower and student alike.

CELERY CULTURE. By R. W. Beattie. New York: Orange Judd Co. 16mo.; cloth; 147 pages; illustrated. Price, 50 cents.

A practical guide for beginners and a standard reference of great interest to persons already engaged in celery growing. It contains many illustrations giving a clear conception of the practical side of celery culture. The work is complete in every detail, from sowing a few seeds in a window-box in the house for early plants, to the handling and marketing of celery in carload lots.

STEAM TRAPS. By W. H. Wakeman. Jersey City: Joseph Dixon Crucible Company. 16mo.; paper cover.

Many steam-users seem to think that the steam trap is a luxury to be indulged in only by the operators of large plants, who can afford to spend their money on useless contraptions which have nothing in their favor except that they are "the very latest." No device that utilizes a waste-product is a luxury, however slight the saving may be; if the saving is great, the device becomes a necessity. The steam-trap can be placed in this last class, for its saving-power, large as it is under any circumstances, increases with the cost of fuel. The Joseph Dixon Crucible Company, Jersey City, N. J., publish a very interesting pamphlet on the subject of steam traps which should be in the hands of every steam-plant operator. It is an illustrated description of the several varieties, with valuable suggestions by W. H. Wakeman, expert steam engineer and author of well-known books on steam engineering.

TOMATO CULTURE. By Will W. Tracy. New York: Orange Judd Co. 16mo.; cloth; 150 pages; illustrated. Price, 50 cents.

The author has rounded up in this book the most complete account of tomato culture in all its phases that has ever been gotten together. It is no second-hand work of reference, but a complete story of the practical experiences of the best posted expert on tomatoes in the world. No gardener or farmer can afford to be without the book. Whether grown for home use or commercial purposes, the reader has here suggestions and information nowhere else available.

ELECTRIC BELLS, INDICATORS, AND AERIAL LINES. By Umberto Zeda. Translated from the original Italian and revised by S. R. Bottone. Authorized edition. London: Guilbert Pitman. 16mo.; cloth; 120 pages; 109 illustrations. Price, 80 cents.

A knowledge of electric bells is almost a necessity to everyone, so widely are they used. The work of which We are writing gives a progressive account of the modern practice for installing electric bells, indicators, and aerial lines, with particular stress upon the many novelties which the Italians have introduced into the usual ways of working.

LESSONS IN LEATHER WORK. By Marguerite Charles. New York: F. W. Devoe & C. T. Raynolds Co. 16mo.; paper cover; 56 pages. Price, 35 cents.

Although the art of leather-decorating reached a very high stage in the middle ages, and for several centuries following, its possibilities are scarcely realized nowadays. The tools required are not expensive, and the skill necessary to achieve at least passable results can be acquired without excessive practice. The translation of Miss Charles's pamphlet should give an impetus to leather-working that will take away the haunting memories of the "burnt-work" horrors of a year or so ago by the attractiveness of the newer products of the art.

THE EFFECT OF DIET ON ENDURANCE. Publications of Yale University. By Irving Fisher, Ph.D. New Haven, Conn., 1907.

Dr. Fisher's monograph is a valuable contribution to the very scant literature on the subject of endurance. His experiments were conducted largely to verify the claims of Horace Fletcher as to the effects upon endurance of thorough mastication combined with implicit obedience to appetite. Dr. Fisher finds that Mr. Fletcher's claims, so far as they relate to endurance, are justified. The results observed during the experiment may be summarized as a slight reduction of total food consumed, a large reduction of proteid element, especially for fresh foods, a lessened excretion of nitrogen, a slight loss of weight, a slight loss of strength, an enormous increase of physical endurance, and a slight increase in mental ability. The practical value of the experiment consists in the fact that any layman can apply it with or without knowledge of food values.

ONE YEAR'S GROWTH IN THE RAILROAD DEPARTMENT FOR THE YEAR 1906 AND THE OUTLOOK FOR 1907. Issued by the International Committee of the Y. M. C. A., 3 West 29th Street, New York city.

To those unacquainted with the ramifications of the organization, the Year Book of the Railroad Department of the Y. M. C. A. will prove a revelation. With its one hundred and sixty-two buildings, this association reaches a membership of over eighty-four thousand; for the most part men whose lives would be devoid of religious influence if it were not for the opportunities of worship offered by this society. When one sees that the attendance upon religious exercises is above 80 per cent of the total number of members, one can draw some idea of the magnitude of the work carried on.

MECHANICAL TRIANGULATIONS IN FREE-HAND DRAWING. By Frank Aborn. Cleveland, Ohio: Cleveland Publishing Company. 12mo.; paper cover; 44 papes; illustrated. Price, 50 cents.

A description of a method of drawing by triangulation, which, when mastered, enables the pupil to make rapid progress in free-hand drawing. Although best adapted for the copying of objects which are all in one plane, the system can be so modified as to be applicable to subjects having three dimensions. The author's manner of expressing his ideas is rather involved in parts of his work, but the benefit derived is quite worth the slight extra trouble in gaining it.

HISTOLYSE, SANS PHAGOCYTOSE, DES MUSCLES VIBRATEURS DU VOL, CHEZ LES REINES DES FOURMIS. Extrait des Comptes rendus hebdomadaires des Séances de l'Académie des Sciences. Paris, 1907. T. 144. Pp. 393.

This short but valuable discussion by M. Charles Janet, well known to entomologists for his splendid studies of ant life, is devoted to an analysis of the system of the muscles which are used by ants but once during their lives and then only for a few hours, only to disappear completely after the nuptial flight. Janet concludes from a minute study of the degeneration of the system that these muscles in the queen ant of *Lasius niger* disappear absolutely without any intervention of phagocytosis.

NAVIGATION BY COMPASS. By Clinton S. Bissell, B.A. Flushing, N. Y.: C. S. Bissell. Paper cover; 32 pages. Price, 50 cents.

A splendid little practical book of instruction on navigation by "Dead Reckoning." By its use anyone with a knowledge of sailing should be able to master the details of the art, so clearly are all the operations explained. Since all the necessary tables are contained in the text, there is a saving in time in bringing up the day's work.

SIMPLE PHOTOGRAPHIC EXPERIMENTS. By F. Thorne Baker. London: Percival Marshall & Co. 16mo.; paper cover; 68 pages; illustrated. Price, 25 cents.

A short treatise for such followers of photography as are of an investigative turn of mind. It contains a number of simple, yet most interesting, experiments with photographic materials that anyone can perform however slight his theoretical training may have been. The directions for making sensitized papers, and "orthochromatic plates" place a most important part of photography within the grasp of the amateur.

LIGHT AND SHADE. By the Duffner & Kimberly Company, New York. 16mo.; paper cover.

A really charming little book on Period Decoration, showing how the products of the firm by whom it is published have been developed along harmonious lines. The text is most instructive and readable, and the illustrations are of a very high artistic quality.

THE LONG LEAF PINE IN VIRGIN FOREST. A Silvigil Study. By G. F. Schwarz. New York: John Wiley & Sons. 16mo.; cloth; 135 pages; illustrated.

Like all nations that have had enormous natural resources at their disposal, we have been lavish of our timber supply. Our forests were so widely extended that it seemed absurd to think that they could ever be exhausted. Now we realize that we can hope to have a sufficient supply of lumber for our future needs only by carefully guarding our remaining woodlands. This volume adds to the knowledge of the life-history of a most important forest tree, the "long leaf pine." Along almost the entire southern seaboard, as well as in several isolated areas, this tree is the prevailing timber-growth; its lumber value is correspondingly great. Mr. Schwarz has had admirable opportunities to study the various conditions described in his book, and has produced a work of value to all who take an interest in the welfare of our forests.

REMPLACEMENT DES MUSCLES VIBRATEURS DU VOL PAR DES COLONNES D'ADIPOCYTES CHEZ LES FOURMIS, APRES LE VOL NUPTIAL. Extract des Comptes Rendus Hebdomadaires des Seances de l'Acadèmie des Sciences. Paris.

The wing-muscles of ants function during a period which may not be more than a few minutes in duration. The investigations of M. Janet show what becomes of these muscles, the most bulky of those which the insect possesses.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending June 11, 1907.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Acid, manufacturing dialkylbarbituric, M. Conrad 856,622
Adding and subtracting machine, J. C. Epeneter 856,235
Adding machine attachment, A. Pentecost 856,965
Addition, apparatus for, G. Nahlik 856,480
Adjustable stand, H. & A. J. Buckland 856,679
Adjusting device, H. G. Beede 856,507
Aerial vehicles and other structures, connection device for the frames of, Bell & McNeil 856,838
Aerial vessel, L. D. Merrick 856,895
Air ship, W. Hull 856,876
Alloy, aluminium, A. Chambaud 856,392
Alloys, producing of calcium, von Kugelgen & Seward 856,475
Ambulatory wheel, W. T. Jones 856,259
Anchor compartment, Fraser & Jackson 856,239
Animal trap, J. M. Kellogg 856,883
Animal trap, C. F. Lamp 856,889
Animals from stables, means for releasing and leading, A. T. Ruthven 856,727
Arch support, D. Livigmano 856,712
Ash and garbage receptacle, combined, J. Kolouch 856,264
Assembling apparatus, N. Marshall 857,095
Atomization apparatus, W. L. Root 856,301
Automatic switch, G. Matthews 856,892
Automobile wheel, J. R. Barker 856,757
Automobile driving mechanism, F. J. Newman 856,486
Bait hooks, jiggers, and like angling devices, attachment for, J. W. Hayward 856,867
Baking powder and making the same, O. Best, et al 856,672, 856,673
Ball bearing wheel, F. J. & H. J. Hansen 856,634
Banjo support, F. B. Piper 856,804
Barrel chiming and crozing machine, C. J. Alley 856,561