power. A. With a horse power equal to 33,000 foot pounds per minute, the power of an average strong man working to the best practical advantage for 10 hours is 4,200 foot pounds per minute. On short spurts can accomplish from two to three times as much, or half a horse power.

(5507) G. W. T. says: In this valley the coal is let down from the opeuings on the hills by wire cables and large drums and the speed is controlled by iron bands or brakes applied to the outside of the drums. Why is it that the bands or brakes wear faster than the iron plating on the drums? They are all the same kind of iron, and the band reaches nearly around the drum, but the plating on the drums will outwear three bands of the same thickness. A. Brake bands are generally much thinner and have less wearing surface than the drum band; besides the motion of the drum band tends to keep it cool, while the friction on the thin brake band makes it hot, and hot iron wears faster than cold iron.

(5508) G. E. P. writes: Can the simple electric motor described in SUPPLEMENT, 641, be run an hour or so a day by three storage battery cells which are charged the rest of the twenty-four hours by six cells of gravity battery? A. Yes; but you will need eight cells or more of gravity batteries for charging.

(5509) W. A. P. asks: How to hard solder one of those aluminum World's Fair sonveuirs and also how to soft solder on the same. A. For hard solder for aluminum, use an alloy of 6 parts aluminum, 4 parts copper, 90 parts zinc. Use Canada balsam for flux. For soft solder, an alloy of 95 parts of tin, 5 parts bismuth, or 5 parts cadmium, 2 parts zinc, 3 parts tin, using paraffine or vaseline for flux.

(5510) M. W. S. asks: In what proportion should air and ordinary illuminating gas be used in a gas engine to produce the best results? A. The constituents of ordinary illuminating gas vary somewhat in different cities and require a variable amount of air for perfect combustion; 8 to 12 volumes of air to 1 volume of a good quality of gas will produce the best result.

(5511) A. C. McG. says: Will you please inform me what chemicals are used to perform the trick of smoking from two clay pipes, by holding the bowl of one over the other? A. Hydrochloric acid and ammouia are used for this purpose.

(5512) W. W. Brown, Culbertston, Neb., writes: Under Notes and Queries (No. 5356) B. C. W. asks if there is any kind of a flux that can be used better than borax. I have a patent on a flux that will do the work he desires and will be pleased to be placed in commuuication with him.

(5513) R. E. B. asks: How is the power determined to drive a boat of a given size at a certain speed? This is for small boats of from 18 feet to 40 feet long. A. So much depends upon the lines and build of boats, together with the varying weight of the power, that computation of the power required for stated speed becomes somewhat complicated. The approximate formula is $\frac{V^3 D^{\frac{2}{3}}}{C} = 2$ H. P. In which V^3 is the cube of the required velocity in knots per hour, $D^{\frac{2}{3}}$ is the cube root of the square of the displacement in tons, C is a coefficient for the water lines of the boat, which for launches and small steam yachts may vary from 500 for medium lines to 530 for sharp lines. The displacement should be computed for the total load, boat, machinery, water, fuel and persons.

(5514) E. S. McI. says: It is stated by the highest engineering authorities that the passage of impure water through sufficient gravel or sand will remove the impurities and make even sewage water wholesome and well tasting. Can you inform me what value as a filterer have the cinders from anthracite coal taken from under a boiler? A. The statement of engineers may be true in regard to the insoluble elements of sewage, but the soluble salts, urates, etc., have been traced a long way through the waterways of the ground, less through the loams and quicksand, but to an almost unlimited extent through the coarser gravels forming the principal underground waterways. When sewage is filtered through thick beds of material, so as to maintain the nitrifying organisms, which are supposed to be supported by a proper supply of sewage, there are possibilities of potable water being a product of such filtration. Gravel bed surface filtration has been found very efficacious in purifying sewage. Drinking the effluent is hardly to be recommended. Clean ashes from under a boiler should make a fairly good stratum in a filter after the soluble salts of the coal and wood are removed. The ash stratum should be protected by sand.

(5515) J. B. says: I am at present experimenting with a toy balloon. For a certain purpose I would like to have this balloon carry a weight from 3 to 4 ounces. The common toy balloon filled with coal gas has no lifting capacity. What I wish to know is whether this same balloon could be filled with some other kind of a gas, to give satisfaction. If this is possible, please let me know. A. If hydrogen gas were used, it would lift more than the coal gas. But it would require a balloon of say 6 cubic feet capacity filled with hydrogen to lift 4 ounces weight.

(5516) B. S. says: Will cedar or cypress tanks (or leach tubs) for tan liquors last the longest without rotting and how long will they last if well taken care of? A. There is very little difference in the lasting qualities of cedar and cypress for tan bark leach vats.

(5517) C. R. — Clean celluloid collars and cuffs with saleratus and water, using an old nail brush if desired.

(5518) F. De T says: Kindly give rule: How heavy should the joist be under a tank holding 18,000 gallons water, 40 feet from the ground, and are 12 x 12 heavy enough for uprights and plates, if properly braced? A If your tank is circular, 15 feet diameter by 15 feet high, the joists should be 4 x 12, 2 feet apart. Uprights and plates 12 x 12 inches.

(5519) F. M. says: Will you please state the difference of cost (used for cooking and furnace heating) against anthracite coal at $4.75 per ton of 2,000 pounds? Oil can be obtained for 5 cents per gallon or less, delivered in the tank. Would not two barrels of oil contain as much fuel as one ton of coal, taking combustion and advantage in controlling the use in consideration? A. The cost of petroleum at prices named is more than twice as much as coal for a given number of heat units for a constant fire. The only advantage in favor of petroleum at the price named is for the intermittent use of heat, such as for cooking in summer and the generation of steam for sudden and special use.

(5520) J. E. L. Co. asks: In a cylinder 20 inches long by 6 inches diameter, with a piston at one end, we find if subjected to 300 degrees, the volume of air will increase about ⅓. I would like to know the expanding force of the air thus heated, or how much will it move the piston and resist one pound pressure to the square inch? A. By heating the air from 60° to 300° it expands approximately 50 per cent, or 1 volume becomes nearly 1½ volumes, and if confined to the original volume it will have a pressure of 6 pounds per square inch, and will push a piston in a continuous cylinder from 20 inches, as above stated, to 27½ inches under 1 pound pressure per square inch.

(5521) W. A. W.—To make heel ball: Hard suet and beeswax, of each 4 ounces, powdered gum, sugar candy, and Veuice turpentine, of each 1 ounce, ivory black and lamp black, of each 2 ounces. The coloring matter and sugar must be in fine powder. Dissolve the candy in as little water as possible. Melt the suet and the beeswax and add the sirup and the coloring matter, stir thoroughly, then pour into moulds.

(5522) K. S. asks: Is there any difference between an injector and an inspirator? A. There is no difference in principle between an injector and an inspirator. See an interesting illustrated article on injectors in SCIENTIFIC AMERICAN SUPPLEMENT, No. 356.

(5523) J. M. says: I have a cistern that was sunk in heavy clay, then boarded up with inch lumber, leaving a space of 3 inches behind the boards; into this space I packed soft clay and rammed it down tight as I boarded it up. I thought this would hold water and make an inexpensive cistern. I find that it will not hold water. Is there any way in which I can plaster it up with water lime over the boards to make it hold? Or is there anything you could suggest whereby I can fix it to hold in without going to much expense? The cistern is 5×5 and 6 feet deep. To settle a dispute, will you please say how many feet of timber in a stick 12×12 inches at one end and 24×24 inches at other end and 40 feet long, and give figures showing how to obtain the proper answer? A. You cannot do better than to take out the wood and clay tamping of your cistern and make the bottom and sides of Portland cement concrete, 1 part of cement, 3 parts clean sharp sand, then plaster the entire inside surface with pure Portland cement. Your cistern must be circular. For the taper timber. Rule: To the sum of the areas of the two ends add four times the area of the center and multiply this sum by one-sixth of the length. The piece of timber as stated contained 93·26 cubic feet.

(5524) D. F. V. asks: What would be the temperature at points 10, 20 and 40 feet below surface of ground in ordinary soil and does it vary much winter or summer? Also what force per square inch will air confined at ordinary temperature exert if heated from 300° Fah. to 600° Fah.? If compressed to 15 pounds per square inch before heating, would pressure be doubled when heated? A. The temperature of the earth at from 10 to 20 feet below the surface is nearly the same as the mean annual temperature on the surface. In mid-latitudes from 50° to 60° Fah., according to the condition of the surface soil. The increase of temperature downward is also variable, due to the nature and structure of the soil and rocks, the rate varying from 50 to 65 feet in depth for each degree of rise in the thermometer.

(5525) P. J. L. says: I wish to experiment with a hot water radiator for heating a room, and wish to know what kind of the following metals will give off the most heat, cast iron, steel, or copper, with hot water at 212°. Also, what amount of radiator surface is needed for a room 12 x 12 x 9, both for water and steam, and what quantity of water would radiator hold? What degree of heat would be shown on surface of radiator? Would it be possible to heat a radiator of the required size with a center draught lamp or with a gas burner? A. A copper radiator will be the most efficient in heating surface. Your room will require 12 square feet of heating surface for either hot water or low pressure steam. The capacity depends upon the plan of construction. The outside surface should be from 210° to 211° Fah. A large lamp or gas stove will heat the radiator.

(5526) C. P. asks: 1. How can a magnetized watch be demagnetized? Is there any machine for doing same, and where can I get description of it? A. A strong horseshoe magnet is required for demagnetizing watches. See an article on this subject in SCIENTIFIC AMERICAN SUPPLEMENT, No. 668. 2. What would be the size of the smallest boiler to generate enough steam for working the steam turbine described in No. 17 of this journal, at the rate of 30,000 revolutions? A. A 25 horse power boiler might produce the number of revolutions you mention.

(5527) E. E. asks if it would be possible to read messages that were being transmitted through an ocean cable by inductive means, after grappling the cable and lifting it to the deck of a vessel. A. We think this would be impossible, on account of the use of a very weak current in the cable for transmitting messages and the ability of the metallic protecting covering of the cable to absorb practically all of the inductive impulses.

(5528) P. G. asks: 1. What would be the power of dynamo described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 161, if changed into a motor? A. About one man power, if supplied with sufficient watts. 2. What different connections are made to change a dynamo into a motor? A. No changes are requisite. The size of wire for winding depends on the potential that is available. 3. Would current enough to run a 6 candle power lamp run the above motor? A. It might run it if the motor was well constructed, but with very little power.

(5529) A. B. C. says: I have a motor like the one described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 759, with the exception that the field magnet is of the horseshoe style instead of the consequent pole type, as shown in that paper. It runs finely with six cells of plunge battery. I would like to rewind it for use on a 220 volt motor circuit. Should it be wound series or shunt? What size of wire and how many layers should I use on the magnet and armature? If it could not be wound for that high voltage, could I wind it for 110 volts and run in series with a 110 volt 16 candle power lamp? A. Wind your motor in series, with enough wire to give a safe current at 220 volts. We cannot do the calculation without knowing the size of your motor. If to be used with the lamp, it may be wound with enough No. 26 wire in field and No. 29 in armature to give 110 ohms resistance. In the calculation take the armature as wound in parallel, giving one-quarter the resistance of its winding.

(5530) W. A. M.—For information in regard to sterilizing milk, see SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 811 and 872.

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