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ard of M. Day, Jr., on advertising page Thomas's Fluid Tannate of Soda removes Scale from Steam Boilers. Saves Boilers and Saves Fuel. Price 10c. per lb. in bbls., ½ bbls., or kegs. For Circular address N. Spencer Thomas, Elmira, N.Y.

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All Blacksmith Shops need a Holding Vise upset bolts by hand. J. R. Abbe, Manchester, N. H. to up Millstone Dressing Diamond Machine-Simple, effective, durable. For description of the above see Scientific American, Nov. 27th, 1869. Also, Glazier's Diamonds. John Dickinson, 64 Nassau St., New York.

Parties desiring Steam Machinery for quar-rying stone, address Steam Stone Cutter Co., Rutland, Vt. Cabinet Makers' Machinery. T.R.Bailey&Vail.

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Mining, Wrecking, Pumping, Drainage, or Irrigating Machinery, for sale or rent. See advertisement, Andrew's Patent, inside page.

Hydraulic Presses and Jacks, new and second hand. E. Lyon, 470 Grand Street, New York

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The Berryman Steam Trap excels all others. The best is always the cheapest. Address I. B. Davis & Co., Hartford, Conn.

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Williamson's Road Steamer and Steam Plow, with rubber Tires.Address D. D. Williamson, 32 Broadway, N. Y., or Box 1809.

Lathes, Planer, Shaper, Shafting, 30 Boilers Engines and Stock of Machine Shop, for sale very low Henry McCollum, Long Island City, N. Y.



J. B. asks: Is there anything poisonous from a cast iron furnace when wood is used for fuel?

J. W. J. says: How can I make a cheap cal-cium light to experiment with? What kind of gas shall I use?

E. T. C. asks: What kind of oil is best for a blacksmith's bellows? Is there anything not injurious to the leather or poisonous that can be used in the oil, that will prevent rats and mice from gnawing the leather?

R. H. D. asks: What advantage have turn-buckles over nuts and check nuts, for the shrouds, stays etc., of small boats? The latter are so much cheaper that I would prefer them if as good.

J. Q. asks: What is the difference in the crushing weights of a stamp that weighs 500 lbs., with a face six inches in diameter, and a wheel that is six feet in diameter and 18 inches face, and weighing eight tuns, rolling or twisting around on a circle of six feet in diameter.

A.Z. says: I have a portable steam engine, 120 lbs. power, 4 feet stroke, and 3% inches bore; the length of the boiler is 6 feet, the diameter 38 inches, with 32 flues. In trying torun a 50 saw cotton gin, I hitched the piston to an ordinary wooden fly wheel with a drum of 5½ feet diameter. The gin runs perfectly well with 70 lbs. of steam, but soon the speed diminishes till it runs very slowly. What must be done to make it run? What is the reason it does not keep its speed? If I attach two small fly wheels to the main shaft of the gin, on one or both sides, do you think that it will help the steam to keep up a sufficient speed?

A. M. says: I am running a circular saw mill, making 500 revolutions per minute. Thesawis 60 inch, friction feed; saw mandel is 3% inches cast steel running in self oiling Babbitt lined boxes. The box next to the saw is hot all the time, but the box next to beltruns cool. Inaverefilled the box several times and in different ways without success. I use lard oil and ave changed mandels twice in sixmonths. It will get hot, whether the saw is on or not, if it runs one hour. Canany one explain?

H. C. D. says: I have an  $18 \times 75$  foot open flat boat, which draws 4 lnches: also have (and wish to apply to it as a power, by suitable cog gearing and pitman connections to a steam wheel) a 10 or 12 horse pow er portable engine of 150 revolutions per minute. to know what are the best length and width of bucket diameter of wheel, and speed of same. What size should the shaft be to drive said boat 3 miles an hour against a current of 3 miles an hour when the hoat is loaded t draw10 inches ?

you please inform us what ingredients and what propor-tion we ought to put in our tank (which we pump from) to prevent the corrosion in the boiler? Would it be best to use copper tubes? Answer: We should require a knowledge of the character of the impurities of the feed water before we could give an intelligent reply.

A. H. M. says: In your paper of March 1, you inform A. B. S. that the back pressure on engine is about  $\frac{1}{2}$  lb. per foot of submerged end of exhaust pipe. If this is correct, please explain this phenomenon. I have a steam pump, and within about ten feet of it stands a cistern, the bottom of which is 6 feet above the exhaust pipe of the steam pump. I placed an upright wooden pipe, 3inches bore, between the pump and cistern, of sufficient length to reach from the ground to above the top of the cistern. I took the exhaust pipe (1½ inc) gas pipe) into the side of the wood pipe, level with the engine, ten feet above, at the top of the wooden pipe. run a 2 inch pipe horizontally over the top of the cistern and turned it down into the cistern, which is 4 feetdeep, within a foot of the bottom. The cistern is usually full, or nearly so, of cold water. The pipes were all airtight from end to end, except a hole,  $\frac{1}{2}$  inch in diameter bored into the perpendicular wood pipe 2 feet below the exhaust pipe, intended to let off the condensed steam. Result: Upon starting the engine (pump), a stream of cold water started from the small opening with the force of say about 10 feet head. I enlarged the hole until finally, I made it 1½ inches in diameter, which had only the effect of increasing the discharge of water. In fact, it made and maintained a continual siphon whether the pump was running or not. The speed of the pump did not appear to be affected, but it occasionally pounded as from waterin the steam cylinder. I finally overcame the difficulty by a valve in the top of the perpendicular pipe opening inwardly, but held closed by a slightspring. Now when it inclines to draw the water over by the vacuum found in the siphon, the valve admits air which the next exhaust forces down into the cistern, keeping up a commotion at intervals of say three to five strokes of the pump. If there had been the back pressure stated could a vacuum have been formed sufficient to have made a siphon? Answer: The arrangement described forms a pretty effective condenser, as first made. As modified, our correspondent will find, we presume should he measure it, a back pressure such as we stated so long as the mingled steam and air are being forced downinto the tank. With a steam engine exhausting into its own feed water tank, the first effect, on starting the engine, might be to produce a vacuum in a simi lar manner, but, as the exhaust is capable of heating sev eral times the weight of the feed to the boiling point condensation would soon cease, the vacuum would be destroyed, and the back pressure would become a load on the engine.

W. S. B. says: I was with Mr. LeVan when he examined the boiler at Conshohocken, Pa. Mr. Le-Van found the iron reduced to three sixteenths in one place, which was not where the boiler burst from the strain upon it, but where the mud drum was torn off. His statement that the steam gage ten minutes before showed a pressure of 53 pounds is incorrect, because there was but one gage in the mill, and the boiler was shut off from that one. There are today worse boilers in this mill working at from 60 to 125 pounds pressure I saw one, this week, taken from the next furnace to the exploded one, with 18 patches on the fire sheets. I heard the proprietor say last summer, in reply to the engineer's opinion that they were carrying too Much pressure, namely 100 to 110 pounds, that it was all nonsense, that those boilers were able to stand 150 pounds pressure. The trouble was that they wanted one man to do three men's work, and one man was doing it for less than one good man's wages, and he forgot to open the connection with the other boilers. The loss of 17 human lives was the result, with many more persons crippled for life. Please state at what pressure the safety valve as described last week, would blow off. Answer: Such an arrangement of steam gage has been a cause of quite a number of explosions of old and worn out boilers. The effort to obtain the labor of three good men by paying a low prize for the time of one man is another cause which, perhaps, operates quite as often in producing ex plosions as almost any cause appertaining to the boiler itself. We fear it may be a long time yet before it shall have become a well recognized fact that nothing is even saved in the long run by attempting to obtain service of any kind without giving the proper equivalent. Should other explosions occur, as apprehended by W. S. B., he will have the satisfaction of knowing that he has done a duty in the premises by giving fair warning through the SCIENTIFIC AMERICAN to those interested. We do not know to what safety valve the last paragraph refers.

J. W. S. says: I am firing a twenty-five horse portable tubular boiler with soft coal. How much more fuel will it take to fire with the furnace door open than with it closed? I run steam Idown hill to one 12 horse engine through 350 feet of 1¼ inches pipe, boxed in and nacked with sawdust. Thinking that some of the power was lost in carrying steam so far, we fitted on a steam gage on steam pipe at engine and found2% pounds more pressure than the gage showed on the boiler. We then placed our gages together on the boiler and found them both alike, both standing at 80 lbs. How does this occur? I have seen it stated in your paper that steam loses one pound in passingthrough each ten feet of pipe. We also run steam up hill 300 feet, in 1½ inches pipe to a 12 horse engine. Placing the gage there, it indicated 5 lbs. less than gage on boiler. But the pipe runs under a road, and the dampness may condense the steam there Does it take more steam to run up hill than it does What is the difference (if nv) in the on top of a boiler and on the bottom ? Take a very light carriage, something like a velocipede only three wheeled with one person on it. How many pounds of force is re quired to propel it one thousand vards, on level ground in one minute, and how much on an iron track? The power is to be applied in the form of a weight.

given. It should be made equal to the difference be tween the least and the greatest radii of the cone.

N. C. M. says: On October 15, 1872, a short time before sunset, I saw a spot upon the sun with my naked eye. Viewed through a field glass of good power, it was resolved into two spots, very close together, and several other smaller spots were visible. The atmo-sphere atthattime was quite hazy. Were the sun spots at that time remarkable for their size? Answer: No-vember 10, 1872, and thereabouts was a period remarkable for the size and number of the spots on the sun; one double spot was to be seen as single with the naked eye. Taking into consideration the time of the sun's revolution on its axis (about 25 days) the same group would have been visible on October 15.

C. W. W. asks: When did the vernal equi-noxfall back from March 21 to March 20? Answer: The answer to the question in regard to the vernal equinox involves the whole theory of the construction of the calendar; it may be found in any encyclopædia and almost every work on popular astronomy. Lockyer's "Elementary Lessons in Astronomy" well discusses the subject, in the chanter on the measurement of time. Our correspondent falls into error in supposing that there is or ever has been any positive fixed date for the occurrence of the equinoxes. It is impossible to avoid some variations, as the time of the sun's revolution from one equinox to the same equinox again is not an exact numper of days. It has been the object of all calendars to so correct the resulting errors that the variations are kept within as small a limit as possible. By the system now in use, instituted by Pope Gregory XIII in 1582, the vernal equinox is always reckoned on or near March 21. This year it happens on March 20.

J. W. P. requests us to publish information about how to make good hard soap, and the chemistry thereof. Answer: To make soap, boil fatty or oleagin-ous matter with a weak alkaline lye rendered caustic by quicklime, and add portions of stronger lye from time and time, the ebullition being still continued until these substances, acting on each other, combine to form a te-nacious compound, which begins to separate from the water; to promote this separation and the granulation of the newly formed soap, some common salt is added and, the fire being withdrawn, the contents of the boiler are allowed to repose for some hours in order that the soap may collect into one stratum, and solidify. When this happens, it is pressed into molds or cakes and, when quite solid, cut into bars. If the soap be made from the cheaper kinds of fat, it will hardly acquire firmness to satisfy the thrifty washerwoman; but it can be prevent-ed from melting too rapidly in hot waterby the introduction of 5 per cent of fused sulphate of soda. Ure says that this addition not only hardens the soap, but improves its color.

W. R. J., Jr., asks at what rate and to what extent mercury expands on the application of heat. An-swer: Dulong and Petit found that mercury expands 3550 ofitsvolumeforeachadditionaldegree (centigrade) of heat up to 100° C. From 100° to 200°, the average expansion for each degree is 33 25, and from 200° to 300°

E. C. H. takes exception to our reply to a correspondent that the rotundity of the earth is Sinches per mile. By the rotundity of the earth, expressed in inches, we mean the distance of the surface of the planet from the extremity of a line whose other end is tangential to the curve. The common formula is: 3% of the quare of the distance in miles will give the rotundity in feet. Square of 1 mile is 1; % of 1 foot is 8 inches.

P. L. D. asks: Can any of your readers give any information as to the best method of making paper transparent, but the substance used must not prevent the use of mucliage on the paper? Answer: Canada balsam and turpentine make a good preparation for tracing paper.

L. E. H. asks: What regions of the world produce gutta percha, and India rubber or caoutchouc? Answer: Gutta percha comes chiefly from Borneo and other islands of the East Indian archipelago, and caoutchoucfrom South America and the East Indies.

W. F. C. S. asks: 1. What proportion ought the tooth of a gear wheel to bear to the space between it and the next tooth? 2. We have a six wheeled witchengine with four equalizers, two on each side The engine when started with a train of cars would cock up her front and duck her rear, as far as the verticalplay of the jaws would allow. The fault was discovered to be caused by the front equalizer. How is this? 3. What is meant by the point of suspension being above the center of gravity? Is it as seen in a scale beam? Answer: 1. The side clearance in gear wheels will properly vary with circumstances. We have seen but a sixteenth allowed in a well cut mortise gear of 4% inches pitch, and, on the other hand, that amount of clearance is none too great, in a rough cast gear of an was tied down forward, while, with the first, as we understand the two arrangements, the equalizers allowed the main frames to take a position in line of draft 3 Precisely.

H. P. & C. asks: In the construction of a hydraulic ram should the pipe that conducts the water from the ram to the place required be larger at the axle and or vice versa? Is tin lined lead pipe preferable to ordinary gas pipe for that purpose? Answer: A pipe of the same size all through will do. Tin lined pipe unnec-

J.B.J. says: You replied to P.R.S. who want-

Brown's Coalyard Quarry & Contractors' Ap-paratus for hoisting and conveying material by iron cable, W.D.Andrews& Bro.414 Waterst.N. Y.

'The Berryman Heater and Regulator for Steam Boilers-No one using Steam Boilers can afford to be without them. I. B. Davis & Co.

Belting—Best Philadelphia Oak Tanned. C. W. Arny, 301 and 308 Cherry Street, Philadelphia, Pa. J.R.Abbe, Manchester, N.H., sells Bolt Vises.

Peck's Patent Drop Press. For circulars, adress the sole manufacturers. Milo, Peck & Co., New Haven, Conn.

Circular Saw Mills, with Lane's Patent Sets; more than 1200 in operation. Send for descriptive pam phlet and price list. Lane, Pitkin & Brock, Montpeier, Vermont.

Key Seat Cutting Machine.T.R.Bailey & Vail.

Tree Pruners and Saw Mill Tools, improvements. Send for circulars. G.A.Prescott, Sandy Hill, N.Y.

Five different sizes of Gatling Guns are now manufactured at Colt's Armory, Hartford, Conn. The larger sizes have a range of over two miles. These arms are indispensable in modern warfare.

Boring Machine for Pulleys-no limit to capacity. T. R. Bailey & Vail, Lockport N. Y.



C. C. S. asks: How can I construct an ice Answer : Read page 88 of our volume XXVI.

H. E. B. repeats B. W. C.'s query. Answer See our reply on page 171 of this volume

D. A. **K**. will find full directions for a bath for nickel plating on page 65 of our volume XXVI.

W. E. G. says: I received the SCIENTIFIC AMERICAN dated March 1st on February 22 containing "Index of inventions for which letters patent of the United States were granted for the week ending Janu ary 28, 1873, and each bearing that date;" how can this be when you publish your paper and subscribers receive it on February 22? Answer: The SCIENTIFIC AMERICAN for each date is issued in the preceding week, and contains the latest Index of Patents published by the Patent Office. Our correspondent's statement is perfectly correct.

C. E. G. says: I want to know how the black glove finish is put on to such articles as harness buckles. Answer: Dissolve three sticks of black sealing wax in half a pint of alcohol. Apply with a sponge.

J. L. J. asks: What do you mean by exces-sive priming? Answer: Priming is water carried into the cylinder of an engine by the steam, and it causes pounding of the piston and wears away both piston and cylinder. Dry steam alone should be admitted to an engine. In answer to your other question : Yes, very creditable. Persevere.

J. B. F. asks: Why is there a star marked in the constellation *Leo* (second star from point of the Sickle) called *Ras-al-Asad*, of the third magnitude, while it is not to be seen there? Answer: This star (called *Rasalas* in Procter's atlas) is to be seen at any time in the designated place.

Several correspondents have called our at-J. A. & Co. say: We put a set of new tubes in a small upright boiler; and in eleven months they were corroded so that we had to putin another set. Will SCIENTIFIC AMERICAN. The length of line BC is not

horse power steam engine per hour; your answer is from 50 to 200 gallons per hour, according to quality of boiler and machine. Is the answer correct? Should it not be perday? Answer: Our reply reads as we intended it should. A good 10 horse power engine with equally good boiler should require about 50 gallons of water per our. This is something over 300 pounds, and it would be evaporated by 30 pounds of coal. Three pounds of coal perhorse power per hour is extraordinarily good workforsuch small power. About 1,700 pounds, or 200 gallons of water requires frequently 200 pounds of coal for its evaporation, and a ten horse engine has been known to reach this figure on many occasions.

W. H. W. asks: How is petroleum applied oboilers to remove scales, I mean such as locomotive boilers, that cannot be got into? Is it not apt to make and just before filing it, put in the petroleum. Then turn on the feed, and as the boiler fills, the oil, floating on the water, reaches every part and saturates every square inch of incrustation.

M. J. D. asks: Will you give me the rule for finding pressure per square inchon slide valve? Anawer: We know of no recorded experiments on this point. If our readers can give the information, we shall be pleased to receive it. We think that some of our friends of the Engineer Corps of the navy can enlighten