FAIRBAIRN ON STEAM BOILERS.

There is another question relating to the strength of boilers which requires careful attention, viz., the internal flues and their resistance to external uniform pressure. In calculating the strength of boilers the internal flues, until of late years, were never taken into account. They were always considered much stronger than the exterior shell, and that there was no danger from collapse. Yet, in the very face of these conclusions, numerous instances of fatal explosions occurred, not from the weakness of the boiler itself, but from collapse of the flues which, at a subsequent period, were found from actual experiment to be the weakest part of the construction.

From the first commencement of boiler construction to a very recent date we all of us acted under the impression that the flues were the strongest part of the boiler, and that a perfectly cylindrical tube, when subjected to a uniform pressure, converging upon its axis, was equal in its power of resistance, irrespective of its length. This was, however, an erroneous opinion, as I found, on submitting a series of cylindrical and elliptical tubes to external pressure, that they were weak, and in many cases, in long boilers, were only one-third or one-fourth the strength of the boiler. This anomalous condition of boiler construction will account for the numerons accidents that have occurred. It has now been remedied; and, by a very simple and inexpensive process, the flues may be strengthened to almost any degree of tenacity, by the simple introduction or attachment of T-iron hoops at certain distances in the length of the flues.

From these experiments, I found that the resistance of flues or tubes varies in the inverse ratio of their diameters; inversely as the lengths, and directly as a power of the thickness. Or it may be stated that the strengths decrease in the ratio of the increase of the diameters and the lengths, and increase nearly as the square of the thickness of the plates. The general formula for calculating the strength of wrought-iron tubes is, where

P = collapsing pressure in lbs.
K = thickness of plate in inches.
L = length of tube in feet.
D = diameter in inches, we have

$$P = 806{,}300 \frac{K^{2 \cdot 19}}{L\ D}$$

or it may be calculated by logarithms, in which case it may be written—

Log. P = 1·5265 + 2·19 log. 100 K — log. (L D).

To illustrate this remarkable law, if we take three flues perfectly similar in every respect, one 10, one 20, and the other 30 feet long, we shall find the first twice the strength of the second, and three times the strength of the third.

It will not be necessary to pursue this part of the subject further except only to direct attention to the following tables, which have been constructed from the experiments bearing directly upon the elastic force of steam, internally as relates to tension, and externally as relates to the collapse of the flues:—

TABLE SHOWING THE BURSTING AND SAFE WORKING PRESSURE OF BOILERS, AS DEDUCED FROM EXPERIMENT WITH A STRAIN OF 34,000 LBS. ON THE SQUARE INCH AS THE ULTIMATE STRENGTH OF RIVETED JOINTS.

Diameters of boilers.	Working pressure for ⅜-in. plates.	Bursting pressure for ⅜-in. plates.	Working pressure for ½-in. plates.	Bursting pressure for ½-in. plates.
ft. in.	lbs.	lbs.	lbs.	lbs.
3 0	118	708½	157¼	944½
3 3	109	653¾	145½	871¾
3 6	101	60[illegible]	134⅝	809¾
3 9	94½	566½	125¾	755½
4 0	88½	531	118	708½
4 3	83⅛	500	111	666½
4 6	78¾	472	104¾	629½
4 9	74½	447¼	99⅓	596¼
5 0	70¾	425	94¼	566½
5 3	67⅓	404¾	89⅞	539½
5 6	64⅜	386⅓	85¾	515
5 9	61½	369½	82	492¾
6 0	59	354	78¾	472
6 3	56½	340	75½	453¼
6 6	54⅓	326¼	72½	436½
6 9	52¼	314⅓	69¾	419½
7 0	50½	303½	67¼	404½
7 3	48¾	293	65	390¾
7 6	47	283¼	62¾	377¼
7 9	45½	274	60¾	365½
8 0	44	265¾	59	354
8 3	42¾	257½	57	343¼
8 6	41½	250	55½	333¼

Rule for ⅜th inch plates:—Divide 4250 by the diameter of the boiler in inches; the quotient is the working pressure, being one-sixth the strength of the joints.

Rule for ½in. plates:—Divide 5666·6 by the diameter of the boiler in inches, and the quotient will be the greatest pressure that the boiler should work at when new; that is, at one-sixth the actual strength of the punched iron.

The above table may be considered perfectly safe for the construction of boilers of good iron, to be worked at the pressure indicated in the second column; and the following table of equal strengths of cylindrical flues may also be relied upon for a collapsing pressure of 450 lbs. per square inch:—

TABLE OF EQUAL STRENGTHS IN THE CYLINDRICAL FLUES OF BOILERS, FROM 1 FOOT TO 4 FEET IN DIAMETER, AND FROM 10 FEET TO 30 FEET IN LENGTH, SHOWING THE REQUISITE THICKNESS OF METAL FOR A COLLAPSING PRESSURE OF 450 LBS. PER SQ. INCH.

Diameter flue in inches.	Collapsing pressure of flue in lbs. per square inch.	Thickness of plates in parts of an inch. For a 10 ft. flue.	For a 20 ft. flue.	For a 30 ft. flue.
12	450	·291	·399	·480
18		·350	·483	·578
24		·399	·548	·659
30		·442	·607	·730
36		·480	·659	·794
42		·506	·707	·851
48		·548	·752	·905

[To be continued.]

THE CROPS—BI-MONTHLY REPORT OF THE AGRICULTURAL DEPARTMENT.

We have received from the Agricultural Department of the Government the "Bi-monthly Report for April and May," and find in it the first summary of the very extensive inquiries organized by the Department in relation to the condition of the crops throughout the country. A correspondence is opened with an intelligent resident of each county in every State, who reports the condition of the crops in his county as compared with the average of the ten previons years. If the crop is estimated at just the same as the average, he marks it 10; if it is one-tenth better he marks it 11; if it is one-tenth short he marks it 9. The clerks in the Department then calculate from the reports of the several counties the mean for the whole State, and these are published in the Bi-monthly Reports. They, of course, furnish a far more valuable estimate of the yield of varions crops throughout the country than can be obtained from any other source. Had we room to spare we should publish the tables in full, but as it is we can give only the summary of the Commissioner.

FRUIT CROPS.

"The tables exhibit the general condition of the fruit and grain crops on the first of June. As was to have been expected from the character of the winter, this condition presents two general differences—in the East all crops promise abundantly, but in the West the fruits and fall-sown grain crops have been much injured by the intense severity of the cold at the close of the year 1863 and the cold of February, when there was but little snow on the ground, in nearly all localities. We will briefly notice each of the crops referred to in the tables.

"*Apples.*—In the Eastern and Middle States the crop will be a good one, but still there are localities where the wet weather caused the fruit to fall off. In the West a general complaint is made by our correspondents of this falling-off; and although the amount of the bloom indicates sufficient for an excellent crop, yet an injury which destroys a fourth of the fruit buds so as to prevent their blooming, is nsually fatal to the setting of the rest.

"*Peaches.*—This crop is in good condition in the Eastern States; in the Western it is destroyed, with a large number of the trees, mostly the old ones. Canning peaches may therefore be looked upon as profitable to those having them during the next fall.

"*Pears.*—The pear has not yet reached a point in its cultivation when it may be regarded as a general market crop, but its hardiness has recommended it to every section of the country, and it is rapidly becoming more than a simple garden product. Like all other fruit crops, it is good in the East; in the West severely injured.

"*Grapes.*—The column asking which variety was most injured, and which the least, has been left blank, for the answers require a more carefnl arrangement than could be shown in the table. The returns connect themselves with many letters accompanying them; hence they will not be given until in our next report.

"*Maple Sugar and Molasses.*—It is gratifying to see the great increase in this manufacture. It will serve to keep down prices of the imported, as well as the amount of their importation. Should the crop of sorghum be favored with a good season, the country will supply its own wants and those of the smaller towns. The *quality* of the maple sugar is spoken of as good.

GRAIN CROPS.

"*Winter Wheat.*—The figures given in all the tables do not *directly* express the amount of the injuries. Thus 8 denotes an injury of *two-tenths*, and not *eight-tenths*, for the starting point in all estimates of an increase or decrease is at 10; thns 11 means an *increase* of *one-tenth*, and 9 a *decrease* of *one-tenth*.

"It will be seen that the winter wheat is in general good condition in the Eastern States, but in New York it is frozen out three-tenths, or thirty per cent., in Pennsylvania three and a half-tenths, in Maryland two and one-third tenths, in Kentucky and Ohio four-tenths, and in the rest of the Western States from three to three and a half tenths. This will lessen the wheat crop at least *thirty per cent.* from the yield of last year.

"The general growing condition is good; in some northern localities dronght prevails, which reduces it below a general average in several of the States.

"*Drill and Broadcast Sowing.*—There is a marked difference in the loss by freezing between the drilled and broadcast sown. The canse of the injury varied in different localities; in many it was by upheaval, in others the roots were killed by exposure to intense cold without any protection, and in others by being covered with water, which froze so intensely as to destroy the roots of the wheat. The most marked difference in favor of drill-sowing was in the first of these canses. But these returns, too, so connect themselves with the information communicated by letter, that we reserve further comment until the next report.

"*Spring Wheat.*—This crop is looking unusually well, but it will be seen from the table that an average amount is not sown. The lateness of the spring and the great scarcity of labor prevented; but it is so nearly an average crop that, with no further drawback upon it, it will be excellent.

"*Barley.*—This is one of the most favorable crops, both in amount and its growing condition. It is above an average in both, and not a single complaint has been made about it.

"*Corn.*—The lateness of the spring retarded the planting of this crop, but the subsequent favorable weather brought it forward rapidly. In some northern localities it had to be replanted where put in early, but generally the crop never came up more favorably. The only State which returns a much lessened planting is Missouri, showing the effects of the war. In many places there are neither laborers nor fencing. In some States, as Winconsin and Minnesota, the crop is not in good growing condition. This is occasioned by drought; but generally our correspondents speak in most satisfactory terms of the prospect when their returns were made on the first of June.

"*Oats.*—A few words suffice for this crop. It was never as good as now, either in amount or growing condition.

"*Clover.*—This crop is highly favorable, both for pasture and hay.

"*Sheep.*—The condition and increase of these continue as heretofore reported, and the wool crop will be excellent. The next report will show the amount of wool clipped, and whatever else in our foreign imports and domestic consumption that will be of interest to the farmer.

"*Weather.*—The table exhibits a large proportion of 'wet weeks.' It was this state that so much favored the crops, especially of the fall-sown kinds.

"Since the foregoing was prepared for press, personal observation, and numerous reports from others, enable us to say that the hay crop of Pennsylvania, Delaware, Maryland, and probably all the Eastern States, has seldom, if ever, been excelled in quantity and quality, and is being secured in the best condition. The crops of wheat, oats and corn, in the same sections, are also as promising as ever seen at this season."

Our observation in reference to the hay crop in Connecticut and western Massachussetts is, that, in consequence of the protracted dry weather in June, it will be light. The season opened favorably, but grass in the old fields was much stunted for want of late rains.

PHOTOGRAPHIC ITEMS.

NEW METHOD OF PRINTING.

The photographic world is at present greatly interested in a new method of printing pictures, lately made public by Mr. Joseph W. Swan, of England. On the 5th of April, 1864, he appeared before the London Photographic Sooiety, and made a full statement of his new method, and presented a large number of beautiful specimens. The members of the society, among whom were many of the leading photographers of Great Britain, expressed their approbation of Mr. Swan's method, and pronounced the pictures in some respects superior to those which result from the present plan of nitrate of silver printing. There is a beauty in the gradation of the tones and a brilliancy of effect that cannot be imitated by the silver process. Specimens of the new pictures have been sent to this country. The editor of *Humphrey's Journal*, having examined some of them, says:—"The softness of tone, the accuracy of shading, and the peculiar color and glows, are strikingly pleasing at first sight, and do not become impaired by a more intimate inspection." The editor of the *Philadelphia Photographer* says of them:—"They are *wonderful* specimens of art, and are sure to make the old silver process so ashamed of its dark deeds that, like Judas, it will go commit suicide, and leave a name to be only despised when remembered." M. Gaudin, an eminent French photographer, speaking of Mr. Swan's pictures in *La Lumiere*, says that "it is impossible to imagine anything more perfect."

It appears to be the general opinion of the leading photographers of both hemispheres that the new process has something in it of great value. We hope that American photographers will not be backward in examining the subject, and putting it into practical use. The following is Mr. Swan's process:—

"The chemical principle is this, that gelatine, in combination with a salt of chromium, becomes insoluble in water after a short exposure to sunlight. This principle is capable of application to photography in many ways, one of the most obvious of which is to attach to paper a suitable tissue, and cover it with bichromated gelatine having a pigment mixed with it; expose this tissue to light, under a negative, and then wash away those portions of the coating not affected by the light. The exposed parts, having become insoluble, remain attached to the paper, and so produce a picture. The mixture of gelatine consists of one part of a solution of bichromate of ammonia (containing one part of the salt in three parts of water), two parts gelatine, one part sugar, and eight parts of water, with coloring matter added to produce the depth of tint required. The pigment used is Indian ink, either alone or mixed with indigo and carmine.

"The tissue is formed by coating a plate of glass or other smooth surface—first with collodion, and then with the colored gelatine mixture above described: the two films unite, and, when dry, may be separated in a sheet from the surface they were formed on. By this means a pliant tissue is obtained, which may be handled like paper, and may either be used in large sheets or cut up into pieces of any convenient size. The tissue, prepared in the manner described, corresponds with sensitive paper, and with proper appliances, the preparation of it need not be more troublesome than the double operation of albumenizing and exciting paper in the usual way. The tissue is much more sensitive to light than ordinary sensitive paper, and proportionately more care must be exercised to guard it from the action of light other than that which acts upon it while in the printing-frame. Like sensitive paper, too, it is better used soon after its preparation. The printing is done in the usual way, the tissue taking the place of sensitive paper, the collodionized surface being placed next the negative. The sensitiveness of the tissue may of course be varied by varying the proportion of the components of the gelatinous part of the tissue; but with the mixture given, the time of exposure required is only one-third or one-fourth of that which would be usually given with highly sensitive albumenized paper.

"The proper time for exposure can be determined pretty accurately, after a few trials; for, although there is not the same means of judging of the progress of the printing in the ordinary process, yet there is a far wider range between under and over exposure than in silver printing. It is no exaggeration to say that you may expose one piece of tissue twice as much as another, and yet obtain a good print from both; not perhaps quite so good as between the two extremes, but yet much more passable than would be the case with silver prints under and over exposed to the same extent. On taking the tissue from the printing-frame the image is faintly visible, and the next step in the process is to mount the tissue, with the collodionized face down, upon a piece of paper, or any other suitable material, to act as a support during development, and sometimes to form the basis of the picture, which may, if we please, remain permanently attached to this support, or may, if thought better, be afterwards transferred. There are several ways of mounting the tissue, and several adhesive substances may be used for the purpose, such as starch or a solution of india-rubber and dammar in benzole.

"After mounting, the tissue, with paper attached, is placed in water of about 100° Fah. The water presently begins to dissolve away the non-solarized portions of the gelatine, and in a few minutes the picture is fully disclosed. It is, however, advisable not to hurry the operation, but to give the water ample time to dissolve out the bichromate. It is also advisable to change the water three or four times. Leave the prints about two hours in the water. Where the picture has been over-exposed, longer immersion and hotter water will, in a great degree, rectify the mistake. Before finally removing the prints from the water, brush their surface lightly with a broad camel-hair brush; and, after taking them out, pour a stream of water over them to remove any loosely adherent particles of foreign matter that may by accident have got attached to the surface. The prints may then be hung up to dry, and are finished by being mounted on card-board and rolled, in the usual manner. Another way of proceeding is to remount the developed print, face downward, upon a second piece of paper or card-board—say with starch or gelatine—and, when this is dry, to remove the paper that was attached to the tissue previous to development; this can easily be done if the surface of the paper is moistened with benzole. In one way the image is reversed, and the collodion surface is downward; and in the other the image is not reversed, and the collodion film is uppermost. In practice, probably, the simpler mode will generally be preferred."

RECENT AMERICAN PATENTS.

The following are some of the most important improvements for which Letters Patent were issued from the United States Patent Office last week; the claims may be found in the official list:—

Machine for heading Bolts.—This invention relates to a machine for heading bolts in which the bolts are held stationary by means of two jaws while their heads are exposed to the successive action of a series of heading dies striking the sides and the top of each head; these heading dies are adjustable to suit heads of different sizes, and they are operated by hinged spring dogs which are connected to a foot lever in such a manner that by stepping on the same the dogs are successively thrown in working position causing two of the heading dies to act first on two opposite sides of the head, and the second pair afterwards; and, finally, the vertical die is set in motion and caused to act on the top of the head; and by these means all sides of the head and its top are smoothed without moving the bolt in the jaws. The foot lever connects with a guide lever, the position of which is determined by a cam groove in the circumference of a revolving drum in such a manner that the foot lever is prevented from throwing the spring dogs in gear with the heading dies at the wrong point. Finally, the connection between the foot lever and hinged dog acting on the vertical heading die is made by means of a spring rod, and a yielding bolster is inserted between said dog and its connection with its crank shaft, in such a manner that the dogs of the horizontal dies will be thrown in gear before that of the vertical die; and in case said vertical heading die meets with an undue resistance it is allowed to yield, and injury to the working parts of the machine is prevented. James Minter, of Worcester, Mass., is the inventor of this improvement.

Preserving Meat.—This invention consists in exposing the meat to be preserved before it is put upin packages, to a heavy pressure in such a manner that nearly all the water not chemically combined with the meat and a large quantity of air contained between the various pieces and in the pores of the same is expelled before the meat is put up in the packages, and by these means the principal agents of putrefaction are removed and its bulk is considerably reduced. It consists, further, in a press-bar provided with a hinged end and movable screw top, in combination with a follower, and also with a frame fitting to the end of said press-box, capable of receiving and holding the mouth of the package to be filled with meat in such a manner that by removing the top of the press-box the meat can be easily introduced, and by closing down said top it can also be readily compressed to agree with the size of the package; and after it has been compressed, by opening the movable end of the press-box and putting the package in its place, the compressed meat can be easily forced into the package without exposing the latter to any undue strain or pressure. W. C. Marshall, of New York city, is the inventor of this improvement.

Propeller—This invention consists in providing a vessel with an iron frame at its stern to form a support for the rear end of the propeller shaft, and also in constructing the rudder stem in such a manner that it may be connected with the propeller shaft back of the propeller wheel. The object of the invention is to obtain a propeller which, with its necessary connections, will be fully protected from shot and also from drift-wood and ice, afford superior facilities in guiding, backing and turning a vessel, convenience in repairing, and which may be operated with but little labor. O. C. Phelps, of New York city, is the inventor of this improvement.

The claims of the following notices appeared in the list issued July 5, 1864:—

Cultivator.—This invention relates to that class of cultivators which are intended to straddle a row of corn or other plants, and which are so constructed that the plows can be readily depressed in or raised from the ground by the action of a hand-lever from the drivers seat, and also adjusted to cut in the ground to any desired depth. The plows are adjusted to beams which can be raised and lowered, and they are made reversible so that the dirt can be thrown in either direction. The frame is made in two sections, which can be adjusted further apart or closer together according to the width of the furrows or distance of the hills. A. G. Tucker, of Richview, Ill., is the inventor of this improvement.

Treating Gum for the Manufacture of Varnish.—The object of this invention is to facilitate the fusion and ebullition of such gums as are generally used in the manufacture of varnishes and for other purposes. The gums used in the manufacture of varnishes, etc., are generally exposed to the heat of a coal fire in copper kettles or boilers varying in size; the fire is placed in close proximity to the bottom of the kettle, and the melting of the gums is mostly limited to the bottom of the kettle or boiler. By the ebullition of the gum at the bottom a large quantity of the same, either fused or not, is forced up against the sides of the kettle or boiler, where it rapidly parts with a portion of its caloric and becomes resolidified. In this state it can be remelted with great difficulty, and a poor and dark varnish is the result. This disadvantage is avoided by the application of a jacket of a good non-conductor for heat to the body and cover of the kettle and also by the use of an exhauster so that the melting takes place at a pressure lower than that of the ordinary atmosphere. John Johnson, of Saco, Maine, is the inventor of this improvement.