## Correspondence.

### Steam Boiler Explosions.

*To the Editor of the Scientific American:*

SIR: In your issue of December 17, 1881, there occurs the following:

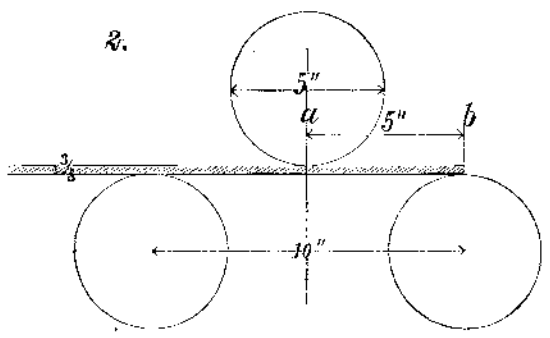
"The owners of these new and apparently well made and thoroughly equipped boilers ought not to be told that it is impossible to determine the cause of the explosion. They, in common with most thinking men, no doubt believe that there was a sufficient cause, which somebody ought to be able to explain."

Forty years' experience as a boilermaker may plead my excuse for meddling with the explosion at the Dayton Wheel Works, Ohio, as reported in your issues of December 17 and January 7. In the last I am happy to see that the bath or wash to which you caused the fractured piece of plate to be subjected has at once and forever put an end to the white-washing of boiler explosions, and revealed what has long been suspected by all intelligent boilermakers of my acquaintance. That suspicion is now seen to be a reality, and the cause of the primary rupture is at once traceable to the bending rollers and the prevailing method of setting the ends of boiler plates for cylinder boilers. In a word, the present system involves the end of the plate first entering the rollers in such a set of circumstances as to insure its destruction.

"The SCIENTIFIC AMERICAN has made a careful examination of the exploded boiler of Messrs. Pinneo & Daniels, and finds that the explosion was due to the bad quality of the iron at the line A B; that the plate at this point was brittle; that this brittle iron was subjected to slight hinge-bending motions caused by variations of pressure on the *flattened* portion of the boiler at the broad seam; that these motions tended to crack the poor iron; that the plate at the line A B showed the existence of a crack of older date than the explosion; that the steam pressure indicated by the engine-room gauge was sufficient to cause the explosion, in view of the cracked and impoverished nature of the iron."

In this quotation one sentence tells the story; it is the following: "The flattened portion of the boiler at the broad seam." This sentence tells a fearful tale with respect to the bending of the plates, for the exploded boiler and the picture of the piece submitted to the bath, shown in the issue of January 7, proves that although the damage done the plate in the process of setting was not visible to the unaided eye, yet it existed, and to such an extent as to render the plate far from being trustworthy. Every blow of the hammer used in the attempt to bend the portion left unbent by the roller is registered on the plate in unmistakable fractures of the material.

While preparing this article for your consideration I have been engaged through the day in the construction of a boiler 6 feet in diameter, plate three eighths of an inch thick, and of the usual quality that is put in shells of mill boilers. Our rollers are 5¾ inches diameter, and the bottom rollers are 10 inches from center to center. Now, as the three rollers are alike in diameter, it follows that when the top roller is three-eighths of an inch above the others, and the plate shoved in, its position will be thus:




You see that from the center of the top roller, *a*, to the end of the plate, *b*, is five inches. This portion of the plate will be unbent and remain so until set by the hammer, which is often done before any further progress is made in the further bending of the plate. The result of this hammering is sometimes the complete destruction of the plate, as in the case of the plate of which I have forwarded you a piece, which has a tongue to tell its own tale. At other times the injury may not be so visible as in the case of the exploded boiler, but nevertheless it is there awaiting the time when it will show itself in the destruction of life and property.

Now, sir, I repeat that the primary cause of the explosion was the damage sustained by the plate in bending, and that all the evils of a wrong system seem to have gathered about that particular *flattened broad seam*, which was, to say the least of it, acknowledged by the engineer to be defective; and inasmuch as it had been calked during the week previous to the explosion it shows plainly that it had never been close.

Now, sir, I blame no man for the explosion. I blame the system which the careful examination, made by the SCIENTIFIC AMERICAN, has brought to light, and enabled me, however imperfectly, to bear witness to the assertion that there was a cause; and from henceforth let it not be said of boiler-makers, when they complain of the rollers, that it is their ignorance and prejudice that cause them to do so. But let there be a careful revision of the whole system, in the interest of truth, justice, and public safety, and manufacturers of boilers and users will all be benefited by the result.

ROBERT PARKER.

## DECISIONS RELATING TO PATENTS, TRADE MARKS ETC.

### Supreme Court of the United States.

STOW *vs.* THE CITY OF CHICAGO.—PATENT PAVEMENT.

1. PATENTEE ENTITLED TO ALL USES OF INVENTION.—A patentee who is the first to make an invention is entitled to his claim for all the uses and advantages which belong to it, and it is immaterial whether he perceived and stated such advantages in his patent.

2. REISSUE No. 3,274.—STREET PAVEMENTS.—ANTICIPATING.—So the wood pavement described in Reissue Patent No. 3,274, *Held* to be anticipated by the patent of Stead, which does not in terms say that the purpose of driving the wedge-shaped block or pile through the space left by the octagonal blocks is to pack the earth or sand foundation, it appearing that such a result must follow from the construction described.

3. LETTERS PATENT No. 134,404.—WANT OF INFRINGEMENT.—When every other part of the invention described in Letters Patent No. 134,404 was shown to be old, doubted whether it can be called invention to have the ground in the spaces between the blocks more compactly rammed, so as to drive it below the under surface of the pavement into the earth foundation; but the evidence failing to show that the defendant used this feature of the invention the bill is dismissed.

Appeal from the Circuit Court of the United States for the Northern District of Illinois.

The first patent relied on is the Reissue No. 3,274, dated January 19, 1869, of an original patent granted to him, numbered 72,110, and dated December 10, 1867.

The invention covered by the reissued patent is thus generally described in the specification:

The nature of my invention consists in putting down a pavement of wood or other suitable material upon a foundation bed of sand or loose earth, and packing the sand or earth by means of wedge blocks driven down into the same and forming a part or whole of the pavement.

The pavement described in this reissued patent consisted essentially of blocks of wood or other material set up on end in rows across the street, with spaces between the rows, in which were driven narrow and probably wedge-shaped blocks, which, when driven down, extended a considerable distance below the under surface of the blocks first named into the foundation bed of sand on which they rested.

No particular form of block is described in the claims, except that some of the blocks used have their lower ends made wedge-shaped. All, therefore, that there is left for the invention described in the first and third claims to cover is the making of the lower ends of a portion of the blocks of which the pavement is composed in wedge shape and the driving of these wedge-shaped blocks below the general under surface of the pavement into the sand or earth bed on which it rests, so as to pack it and render it solid and unyielding.

When thus reduced to what it really is the invention of the appellant is clearly and distinctly anticipated by the English patent issued to David Stead, dated April 23, 1839, which is set out in full in the record.

One of the drawings which accompanies Stead's specifications shows a pavement laid with contiguous rows of octagonal blocks, so placed as to leave rows of square unfilled spaces. In these square spaces were placed square blocks, longer than the octagonal blocks and wedge-shaped at the lower end, and these were driven down into the earth foundation, upon which the octagonal blocks rested.

It is true this specification does not in terms say that the purpose of driving the wedge-shaped block or pile through the space left by the octagonal blocks is to pack the earth or sand foundation, but that it does so as effectually as the use of similar blocks in a similar way under the patent of appellant is too clear for argument.

A patentee who is the first to make an invention is entitled to his claim for all the uses and advantages which belong to it. (*Woodman vs. Stimpson*, 3 Fish., 98.)

It is shown that Stead invented this device. Whether he perceived and stated all its advantages is immaterial. (*Tucker vs. Spaulding*, 13 Wall., 453; Mr. Justice Clifford in *Graham vs. Mason*, 5 Fish., 1.)

Stead's specifications, it is clear, cover (to use the language of Stow's reissued patent), "a pavement composed of wood laid on a foundation-bed of sand or loose earth," and having "a portion of the blocks of which it is composed driven down into said foundation-bed."

Everything, therefore, in the first and third claims of appellant's reissued patent which he sets up as new was anticipated nearly thirty years by Stead's English patent. Appellant's patent, therefore, so far as it covers these claims, is void, and cannot be the foundation of any relief against the appellee.

The other patent which appellant insists that the appellee has infringed is No. 134,404, dated December 31, 1872, issued to appellant as the original inventor.

The invention covered by this patent is described in the claim as follows: "A pavement composed of blocks laid in rows directly upon the sand foundation, with spaces between the rows filled with sand or gravel, which is swaged or driven into sand foundation, substantially as and for the purpose specified."

The use of wood for street pavements, the laying of blocks directly upon a sand foundation, the placing of the blocks in rows, leaving spaces between the rows, are all old devices. As already shown, they are all to be found substantially in the English patent of Stead, issued April 23, 1839, and they are found in the English patent to Lillie, dated October 13, 1860, and the American patent to Richard H. Willett, No. 114,895, and dated May 16, 1871, all of which are put in evidence by the appellee.

The evidence is distinct and clear that the invention thus defined was anticipated by the pavement laid by J. K. Thompson, City Superintendent, in the year 1864, at the intersection of North State and Kinzie streets, in the city of Chicago. This piece of pavement was made of wooden blocks, six inches square, set in rows on an earth foundation, with spaces between the rows, and the spaces filled with fine gravel and the gravel rammed. This pavement was put down by Thompson as an experiment. It proved successful. It was in use until the great fire in Chicago in 1871.

Without noticing the other defenses, we declare our opinion to be that the appellant is not entitled to any relief against the appellee upon either of the patents on which his demand for relief is now based. His case, as presented here, has no ground to stand on. The decree of the Circuit Court dismissing his bill must therefore be affirmed.

Mr. Justice Woods delivered the opinion of the court.

### United States Circuit Court—Southern District of New York.

HART *vs.* THAYER.—PATENT NECKTIE.

Blatchford, J.:

The improvement in neckties set forth in reissued letters patent No. 7,909, which consists in securing a straight pin to the shield by means of metallic fastenings—*i. e.*, metallic rivets either separate from or struck out from the body of the pin, which pass through the shield and are clinched or headed on the opposite side—is not infringed by a mode of securing pins to the shield, which dispenses with separate fastenings, and which consist in forming two bends in the length of the pin, so that by passing through suitable holes in the shield the pin may fasten itself.

This suit is brought on reissue letters patent No. 7,909, granted to the plaintiff, William H. Hart, Jr., October 9, 1877, for an improvement in neckties, the original patent, No. 159,921, having been granted to him February 16, 1875.

### By the Commissioner of Patents.

EX-PARTE FAIRCHILD.

TRADE MARK.—PROPER NAME OF APPLICANT.

The mere name of a person does not form a proper subject for trade mark registration, although it appears that such name, by long association with a certain line of goods, has come to be applied as a name or title to such goods.

MARBLE, *Commissioner:*

Appeal is taken in this case from the decision of the Examiner of Trade Marks, who refused to register the word "Fairchild" as a trade mark, because it was "merely the name of the applicant."

Applicant alleges that the Examiner erred in refusing to register his alleged trade mark, first, because the word "Fairchild" has been used as a trade mark in connection with his manufacture and sale of pens and pencils for twenty years and upward, and is well known to the commercial world as the trade mark of the applicant; second, because said word was registered as a trade mark in this office under the act of July 8, 1870, which act contained similar prohibitions to the act of March 3, 1881.

By the third section of the act of March 3, 1881, it is provided that:

But no alleged trade mark shall be registered unless the same appear to be lawfully used as such by the applicant in foreign commerce or commerce with Indian tribes, as above mentioned, or is within the provision of a treaty, convention, or declaration with a foreign power, *nor which is merely the name of the applicant.*

HELD BY THE COMMISSIONER.

While it may be true that the name of the applicant in his trade is of great value, it cannot receive registration in this office as such in violation of the prohibition of the statute. The prohibition of the statute was intended to prevent any person from using his name in any trade as a trade mark to the exclusion of other persons of the same name in the same or any other avenues of trade. This intention of Congress would not be carried out if registration was permitted of the name of any person as a trade mark, however long it may have been used.

The decision of the Examiner of Trade Marks is affirmed.

### A Smuggling Locomotive.

The London *Times* states that a singular adaptation of the locomotive has just been made in Russia. Information having been given to the authorities at Alexandrovo, on the Polish frontier, that the locomotive of the express leaving that station for Warsaw had been ingeniously converted into a receptacle for smuggled goods, it was carefully examined during its sojourn at the station. Though nothing was found wrong, it was deemed advisable that a custom-house official should accompany the train to its destination, where the engine furnace and boiler were emptied and deliberately taken to pieces. In the interior was discovered a secret compartment containing 123 lb. of foreign cigars and several parcels of valuable silk. Several arrests were made, including that of the driver, but his astonishment at finding the engine to which he had so long been accustomed converted into a hardened offender against the laws was so genuine that he was released and allowed to return to his duties.

### The Channel Tunnel.

The attention which the Channel Tunnel project is attracting in England, chiefly from a military point of view, raises the enterprise to the first place in international if not engineering interest.

The recent sale of the experimental tunnel property of the Southeastern Railway Company, at Shakespeare Cliff, to the Submarine Continental Railway Company, coupled with the fact that the capital of the Submarine Company is now placed, and the further fact that a French company are industriously at work on the Calais end of the tunnel, may be taken as a guarantee that the enterprise has passed beyond the stage of mere discussion, and that unless stopped by government or by unforeseen engineering difficulties or financial disaster it will go on to realization. The English property transferred comprises something over a mile of experimental boring, and three miles of shore within the limits of which alone a tunnel is held to be practicable. Colonel Beaumont, whose machine is used in boring through the chalk, said, at the meeting to ratify the purchase, that the boring is now going on at the rate of twelve yards a day of seventeen hours, but it was expected that by the use of a new machine soon to be put in it would be possible to accomplish one yard an hour. The experimental boring is seven feet in diameter. The chalk on the English side is quite dry; there is no exhalation of carbonic acid, and the compressed air used in running the boring machine secures ample ventilation. The chalk cut out by the machine is delivered in the wagons, only two men being employed at the heading. The proposed point for beginning the tunnel is called Fan Hole, a little eastward of the South Foreland. From the town of Dover the approach would, as is now suggested, pass at a depth of 300 feet below the seaward spur of the outer wall of Dover Castle.

On the French side the company which has undertaken the southern half of the tunnel have made considerable progress in their work. The borings are near the little village of Sangatte, about six miles from Calais. Here the company have erected substantial buildings of brick and concrete for the engines and air-compressing machinery, and a tramway to carry off the material dug out runs to the edge of the cliff, which rises a hundred feet or more above the beach. Recently the works were visited by a number of the officers of the English company.

Two shafts have been sunk at a distance of forty or fifty yards apart, and by the larger of these the visitors descended to examine a horizontal cutting. About 70 feet below the surface the borers have found the *craie de Rouen*, strata corresponding to the lower portion of that homogeneous gray chalk which some geologists have called the chalk without flints. At a depth of 78 feet the brick lining of the pit ceases and the employment of wooden "tubbing" begins, this being carried down to a depth of 204 feet, when the chalk becomes so dry and hard that a lining is no longer required. The depth of the shaft is about 280 feet, and going about 6 feet lower down by a ladder through a hole at one side a gallery, 8 feet high and of the same width, is entered. This opens into one of equal diameter running nearly at right angles, which, with a slightly upward inclination, to provide for drainage, runs in a northeasterly direction, but trending to the northward—that is, toward the sea—with a curve having a radius of one kilometer. It is to be 1,850 yards long. Artificial ventilation has not been found necessary so far, the two shafts, with both of which it is in connection, providing for an up and down current of air. This gallery is about 170 feet below low water mark, but no portions of these workings have yet been pushed out under the sea. M. Alexandre Lavalley, the contractor for the Suez Canal, who has offered to undertake the construction of the tunnel for the French *Concessionaires*, is to drive another gallery of equal length in the same direction as, but not immediately over, the one already begun. He will employ Brunton's cutting machine, while in the lower gallery Beaumont's machine will be used, both machines being driven with compressed air. It is found in the lower gallery that there is but little percolation of water, and that such as runs in comes from springs in fissures. What does flow in is pumped out at the rate of 60 gallons per minute. At a depth of 288 feet a bed of greensand less than 7 feet thick is reached, and then the galt.

The air-compressing machinery on the French side is to be superintended by M. Welker, the engineer who had charge of the machinery used in the St. Gothard Tunnel.

### Color Changes in Sea Waters.

Mr. John Aitken, F.R.S.E., of Darrock, Falkirk, has been working on the cause of the constant change in the color of the Mediterranean and other waters, which he dealt with in a paper read at a recent meeting of the Royal Society of Edinburgh, and in the course of which he explained a series of experiments which he had made to find out the cause of the change. He remarked that the colors of the waters referred to were extremely beautiful, and that they changed from hour to hour and from day to day. The most brilliant effects were seen in the Mediterranean after high winds had been blowing toward the shore, and the tints were so varied that no artist's colors could produce them. Many theories had been propounded in order to explain the phenomena, and one of them was that they were caused by the marvelously blue sky being reflected from the surface of the water. But that theory did not explain any of the effects, because he had frequently seen the Mediterranean deeply and richly colored under a white or cloudy sky. Another theory, called by Mr. Aitken the "selected reflection theory," was that the blueness was produced by the presence in the water of very minute particles, or something in a very minute form, which reflected light. A third theory, called the "selected absorption theory," was that the blueness was produced by the absorption of light.

The author then proceeded to explain the experiments which he had made at Mentone last spring in order to determine which theory was the correct one. By passing the water through long tubes, blackened inside, and with a piece of paper at one end and a mirror at the other, he found that the Mediterranean matter transmitted a blue-green light; and by sinking vertical tubes under the surface of the water with reflectors at the lower end, and looking down at a plate, he found that the blue was of a color too exquisite to describe in words. These results proved that the absorption theory was the true one, and that the selected reflection theory did not hold good. He next sank different colors under the water to a given depth, and found that white changed to blue, that yellow became green, and purple became violet. Perhaps the most satisfactory test was the sinking of a purple colored object about two feet below the surface of the water. It became perfectly blue, the whole of the red component being absorbed.

By means of vessels filled with blue solution, Mr. Aitken demonstrated how solid matter in suspension was necessary to produce the phenomena witnessed in the Mediterranean. The amount of suspended matter in the Mediterranean, he remarked, was something enormous. He subsequently detailed the results of his examination of the waters of Lake Como and Lake Geneva, and stated, in regard to the latter lake, that the white bottom influenced the appearance of the water. He also referred to the examination which he had made of the waters of the west coast of Scotland, pointing out that the appearance of green water was a proof that it was due to absorption, and that the solid matter determined the brilliancy of it. Yellow sand particles produced green water. By distilling water he had ascertained that blue was the color proper to water.

### Methods of Chemically Reproducing Drawings.

The following excellent account of the various processes in use for copying plans by the agency of light is translated in the *American Architect* from the pages of *Le Génie Civil:*

For reproducing a drawing at a different scale from the original, or for copying plans on very thick paper, the assistance of a camera, sensitive plates, reageants of various kinds, and an operator skilled in the difficult manipulations of the photographic art will be needed, but anything which is or can be drawn in line on thin paper or tracing cloth may be copied with simple materials and without skilled assistance.

The simplest method of accomplishing this consists in the employment of the so-called ferro-prussiate or "Marion" paper, which is prepared by covering one side of the sheet with a mixture of red prussiate of potash (ferrocyanide of potassium) and a salt of peroxide of iron; under the influence of light, that is under the white portions of the drawing to be copied, the ferric compound is reduced to the state of a ferrous salt, which gives with the red prussiate of potash an intense blue coloration, analogous to Prussian blue. This coloration is not produced in the portions of the sensitive paper protected from the light by the black lines of the drawing to be copied, and on washing the print the design appears in white lines on a blue ground.

The formula for preparing the sensitive paper is as follows:

Dissolve 8 parts of red prussiate of potash in 70 parts of water; dissolve separately 10 parts of ammoniacal citrate of iron in 70 parts of water; filter the two solutions through ordinary filtering paper, and mix them. Filter again into a large flat dish, and float each sheet of paper to be sensitized for two minutes on the surface of the liquid, without allowing any of this to run over the back of the paper. Hang up the sheets in a dark place to dry, and keep them from light and dampness until used. They will retain their sensitiveness for a long time.

The paper being ready, the copy is easily made. Procure either a heavy sheet of plate glass, or better, a photographer's printing frame, and lay the drawing to be copied with the face against the glass; on the back of the drawing lay the prepared side of the sensitive paper, place upon it a piece of thick felt, and replace the cover of the printing frame, or in some other way press the felt and papers firmly against the glass. Expose, glass side up, to sunshine or diffused daylight, for a time varying with the intensity of the light and the thickness of the paper bearing the original drawing from a few minutes to several hours. It is better to give too much than too little exposure, as the color of a dark impression can be reduced by long washing, while a feeble print is irremediably spoiled. By leaving a bit of the sensitive paper projecting from under the glass, the progress of the coloration can be observed. When the exposure has continued long enough the frame is opened and the sensitive sheet withdrawn and thrown into a pan of water, to be replaced immediately by another, if several copies are desired, so that the exposure of the second may be in progress while the first is being washed and fixed. The water dissolves out the excess of the reagents used in the preparation of the paper, and after several washings with fresh water the print loses its sensitiveness and becomes permanent. It is advantageous, after several washings with water, to pass over the wet surface a weak solution of chlorine or of hydrochloric acid, 3 or 4 parts of acid to 100 of water, which gives brilliancy and solidity to the blue tint, and prevents it from being washed out by long soaking. This should be followed by two or three rinsings with fresh water, and the print may then be hung up to dry, or placed between sheets of blotting paper.

This mode of reproduction, whose simplicity has led to its adoption in many offices, has the inconvenience of giving a copy in white lines on a blue ground, which fatigues the eye in some cases, while the application of other colors is impracticable. By repeating and reversing the process, copying the white line print first obtained on another sensitive sheet, a positive picture, representing the black lines of the original by blue lines on a white ground, can be obtained; or the same result may be reached by a different mode of treating the sensitive paper.

Several varieties of paper called "caynoferric," or "gommoferric," are sold, which have the property of giving a positive image. The mode of preparation is nearly the same for all: Three solutions, one of 60 parts by weight of gum-arabic in 300 of water; one of 40 parts ammoniacal citrate of iron in 80 parts of water; one of 25 parts perchloride of iron in 50 of water, are allowed to settle until clear, and are then decanted, mixed, and poured into a shallow dish, the sheets being floated on the surface as before, and hung up to dry. The solution soon becomes turbid, and must be used immediately, but the paper once dry is not subject to change unless exposed to light or moisture. The reactions involved in the printing process are more complex than in the first process, but present no particular difficulty. Under the influence of light and of the organic acid (citric) the perchloride of iron is reduced to a protochloride, and on being subjected to the action of ferrocyanide of potassium the portions not reduced by the action of the light, that is, the lines corresponding to the black lines of the original drawing, alone exhibit the blue coloration. The gum plays also an important part in the process by becoming less soluble in the parts exposed to light, so as to repel in those portions the ferrocyanide solution. The mode of printing is exactly the same as before, but the paper is more sensitive, and the exposure varies from a few seconds in sunshine to fifteen or twenty minutes in the shade. The exact period must be tested by exposing at the same time a slip of the sensitive paper under a piece of paper similar to that on which the original drawing is executed, and ruled with fine lines, so that bits can be torn off at intervals, and tested in the developing bath of ferrocyanide of potassium. If the exposure is incomplete, the paper will become blue all over in the ferrocyanide bath: if it has been too prolonged no blue whatever will make its appearance, but the paper will remain white; if it is just long enough, the lines alone will be developed in blue on a white ground.

During the tests of the trial bits the printing frame should be covered with an opaque screen to prevent the exposure from proceeding further. After the exact point is reached the print should be removed from the frame and floated for a few moments on a bath of *saturated* solution of ferrocyanide of potassium, about one part of the solid crystals to four of water. On raising it the design will be seen in dark blue lines on a white ground. It is necessary to prevent the liquid from flowing over the back of the paper, which it would cover with a blue stain, and to prevent this the edges of the print turned up all around. On lifting a corner, the progress of the development may be watched. As soon as the lines are sufficiently dark, or blue specks begin to show themselves in the white parts, the process must be immediately arrested by placing the sheet on a bath of pure water. If, as often happens, a blue tint then begins to spread all over the paper, it may be immersed in a mixture of 3 parts of sulphuric acid, or 8 parts of hydrochloric acid, to 100 parts of water. After leaving it in this acidulated liquid for ten or fifteen minutes, the design will seem to clear, and the sheet may then be rinsed in a large basin of water, or under a faucet furnished with a sprinkling nozzle, and a soft brush used to clear away any remaining clouds of blue; and finally, the paper hung up to dry.

The ferrocyanide bath is not subject to change, and may be used to the last drop. If it begins to crystallize by evaporation a few drops of water may be added. The specks of blue which are formed in this bath, if not removed by the subsequent washings, may be taken out at any time by touching them with a weak solution of carbonate of soda or potash. The prints may be colored in the usual way.

### A Simple Automatic Railway Signal.

The New York and New England Railroad Company are testing a system of electric block signals which seems to possess rare merit on the score of simplicity and directness of operation. It was invented by Mr. Charles J. Means. Its distinguishing feature is that the danger signal is set mechanically by the passage of a train and locked by a latch lever bearing the armature of an electro-magnet which is charged by the passage of the train over a track circuit-closer at a suitable distance beyond, say one mile, whereupon the safety signal is displayed.

In this way the entrance of a train upon a block automatically sets the danger signal, which remains exposed until the train leaves the block. Any breaking of the conducting wires or failure of the battery causes a continual display of the danger signal until the fault is corrected. As the disks turn to the danger position they close a circuit which causes an alarm bell to ring at the nearest station, thus warning the agent and proving the signal to be in working order. Special signals are provided for switches and for street crossings at grade.