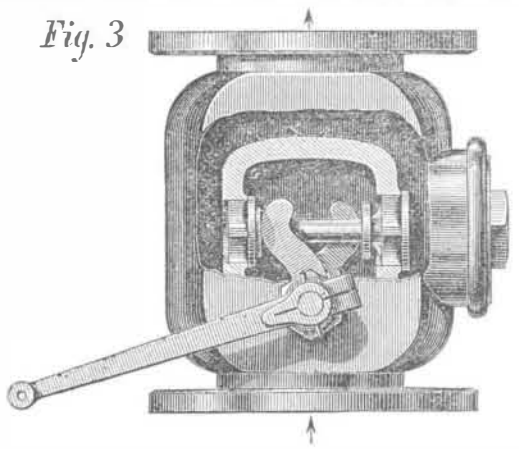
munication with the discharge pipe of the pump, through a connecting pipe, in which is placed a check valve, I, opening in towards the disk. In the spindle of this check valve, a small hole is drilled for the purpose of getting a gradual motion when opening the valve in the steam pipe of a pump, to which it is attached as shown, and is used in feeding a number of boilers regulated by either of the patent regulators. The top side of the disk is connected by a pipe, in which is formed a siphon, leading either from the steam or water space of any one of the boilers, to obtain the same pressure on both sides of the disk. The pressure in the discharge pipe of the pump against the under side of the diaphragm being greater than that in the boilers, the weight and lever are raised.

The operation is as follows: Should all the regulator or feed valves and the feed pipes of the boilers become closed, an increased pressure will at once be thrown on the under side of the flexible disk, and the valve J, in the steam pipe of the pump will be closed, and will remain so as long as the valve remains closed in the feed pipe of the boiler, or as long as the pressure is maintained in the discharge pipe of the pump.

Fig. 3



But as soon as a feed valve is opened, the pressure being reduced, the weighted lever drops to its position again as fast as the water can pass out through the spindle of the check valve, thereby causing a steady movement of the machine. The valves on the feed pipes can all have a slight lead or opening, and thus allow the pump to move constantly at a slow speed. When a plunger pump is used, as in Fig. 1, the valve is placed in the supply pipe, and the pump is allowed to run constantly.

Fig. 3 represents Berryman's balanced valve, patented April 9, 1872. In working his regulator, the inventor found much difficulty in getting a proper valve. In the one now shown in Fig. 3, is found what is essential for his purpose.

The balanced poppet valve in this device has added to it a simple improvement by which the valve is made to rotate on its seat at each time of its opening, causing a constant and equal wear on all parts of the valve and seat. The fork inside has one prong slightly longer than the other, so that at opening, the bearing is on one side of the valve, which tends to rotate it each time it opens. The fork works between two collars or shoulders which allow the valve to move freely; and the inventor states that its construction is such that, having one hundred pounds pressure on the face of one and back of the other valve, it can be opened or closed with a power of less than five pounds on a three inch valve.

For further information concerning all these improvements, address J. B. Davis & Co., sole agents for the Berryman Manufacturing Company, Hartford, Conn.

"GREENBACKS" AND POSTAGE STAMPS.

NUMBER I.

The visitor to Peter Cooper's noble charity, the Cooper Union, in this city, will find that while he is permitted to ramble, unobstructed, around the greater part of the immense building, his entrance to the fourth and to portions of the third stories will be barred by heavy iron gates backed by massive doors, and that his requests for admission to this mysterious quarter will be refused unless he be armed with certain necessary passports. His curiosity, doubtless thus aroused, will be augmented by learning that within those walls, thus secluded from the outer world, comparatively valueless sheets of white paper are changed into millions of dollars, as well as into the stamps which carry his written thoughts throughout the world. In short, the rooms are the workshops of the National Bank Note Company, the corporation that supplies the majority of the money and the postage stamps used, not only in the United States, but in many of the States of Europe, in all of the South American countries, and even in China and Japan.

If the reader will follow us through the processes below described, we will endeavor now to explain how this modern alchemy, which transmutes not baser metals but paper into the equivalent of gold, is carried on. We shall trace the manufacture of postage stamps and greenbacks, in the beginning together, as the various steps are essentially the same, noting, however, afterwards the special points of difference.

The general portion of the work, that is, all the decoration not directly bearing upon the special use for which the note, stamp, bond, bill, warrant, or whatever it may be, is intended, such as border, corner ornamentation, etc., is ready at hand. It has already been drawn and engraved in a manner which will be described further on, and impressions have been taken on paper, so that it is only necessary to cut the latter neatly out and paste them upon a sheet of the required form in their proper places. Then the lettering, vignettes, etc., are carefully drawn, and finally the entire design, which is really nothing more than a patchwork, is finished and submitted. If approved by the Government or party ordering, it is returned with special written instructions as to the details of manufacture. It is then placed in the hands of the workmen, and at this stage we begin our tracing of the process through which it passes to completion.

The first proceeding is making the die. A plate of soft, highly polished steel is selected, and upon it is sketched the design, or, perhaps, such portions of the latter as are of the same color, if more than one tint is to be used in printing. Of course a separate die is needed for every shade used. This is then carefully engraved; the labor is most elaborate and the skill of the operatives wonderful. Steel plate engraving is so generally understood that we need enter into no special description of how it is done; but we simply note the fact that it is the reverse of wood engraving, that is to say, the lines which take the ink are cut into the plate instead of being raised above its surface. The engraver is limited to such parts of the work as can be done by hand; other portions, such as the scrolls and elaborate tracery, are necessarily done entirely by machinery. The principal apparatus used is a complicated piece of mechanism, which we have not space to describe in detail, but which, in brief, actuates a plate to which the steel for the die is attached and caused to press against a diamond point. Perfectly true and delicate lines are thus cut into the metal, making figures technically termed "cycloid rosettes." The machine, in theory, somewhat resembles a kaleidoscope, as it requires to be set by accurate pointers and dials to some special figure, which, when the combination is changed, can never be reproduced. One of these instruments is in use, and its work, together with that of the geometrical lathes, can be readily recognized on the national currency.

The die being now complete, it is ready for the transfer process. Postage stamps, for instance, are made in sheets of two hundred, so that the die must be transferred that number of times on a single plate. It is first case hardened and then put, face up, in a press which is made with a combination of levers actuated by the foot, so as to give the tremendous pressure of twenty-one tuns on a single line. A cylinder or "roll" of soft steel is, by careful gaging, placed so as to rest directly over the face of the die, and, at the same time, is so arranged as to revolve easily along its surface even when under the full weight. The pressure is then applied, with the result of forcing the soft steel of the roll into the lines of the engraving, so that when complete, the periphery of the cylinder shows an exact reproduction of the face of the die, only the lines sunk on the latter are now raised on the former. Next, this cylinder is case hardened. Then the plate —soft steel again—to be used for the final printing is placed in the above mentioned press and the roll arranged above it. Now, the cylinder leaves its impression on the plate, the hard steel of the raised lines cutting deep into the surface, so that a precise duplicate of the original die is obtained. This is repeated for as many times as there are to be repetitions of the stamp or note on the single plate, which is then ready for use. Here we leave it and turn our attention to another part of the manufacture.

The ink for printing is also made on the spot. In a large room are ten or a dozen paint mills, which are busily grinding the colors and oil together. Two large ones are filled with green ink, suggestive of liquid greenbacks, another, with vermilion, while others are making blue, red, and other tinted inks. Nothing but the finest color and the best boiled linseed oil is here used. We now pass to the paper room, where the paper is received directly from the Government, cut in sheets of the required form. The fractional currency and larger notes are made of a peculiar material containing colored fibers, manufactured at Glen Mills, near Philadelphia. The paper for postage stamps is made by the Bank Note Company, of the best linen. It is of short fiber, very fine, and extremely strong. The sheets on which currency is to be printed are counted as soon as received, and the result telegraphed to Washington for verification. Some idea of the accuracy required may be gathered from the fact that, for every sheet unaccounted for, the company has to pay in cash the full value of what *might* have been printed on it; that is to say, if a sheet intended for four $1,000 notes is missing, $4,000 must be returned. The paper varies in size according to the purpose for which it is designed. Thus the sheet for 10 cent fractional currency is 7½ by 16¾ inches, and so on up for the larger denominations. All the paper is not received perfectly blank, for the reason that the National Company prints but one side of each bill. The material for the 15 cent and 25 cent notes is supplied with the backs already finished—the work being done by the American Bank Note Company; while, *vice versâ*, the 10 cent bills are sent to the last mentioned corporation from the National Company in a similar condition. The sheets being counted are placed in heaps, marked off in sets of 100 and 1,000. When issued for printing, the workman receiving them has to present an order signed by the superintendent. They are then charged against him in his pass book, when he carries them away to be damped, this being done by simply wrapping them in wet cloths.

Leaving the paper room, we enter a large apartment, in the center of which are 116 presses arranged closely together. These are simply cylinders moved by long handled levers, and are each attended by three men and a girl. Here we find our plate again, now resting upon a small iron box warmed underneath by gas flames. A workman rapidly covers it with ink with a plate printer's roller and passes it to another operative at his side, who wipes the plate over with a soft cotton cloth, and then polishes with the palm of his hand covered with whiting, thus removing the ink from its surface but not from the engraved lines, which remain filled. This done, the plate is placed, face up, in the press. The girl stands ready with a sheet of damped paper which she carefully lays upon the plate. The pressman turns the levers, the cylinder revolves, the plate passes under it, and the paper is removed bearing a perfect impression. It might be naturally imagined that the workmen engaged in this portion of the manufacture would often succumb to the temptation of furtively running a sheet of ordinary paper through the press, and thus possessing themselves of, say, 200 ninety cent stamps in a moment's time. But such a proceeding is practically impossible. Apart from the constant vigilance of the superintendents, the presses are placed so close together that the men can overlook each other's every action. One of the strongest safeguards is the *esprit de corps* among the workmen themselves. So sensitive are they that they recently insisted upon the discharge of one of their number who, merely to try his press, ran a sheet of common brown paper through it.

As soon as a printer has completed the work assigned to him, he hands it, made up in "books" of 100 impressions, each sheet inclosed between two others of brown paper, to a clerk. He is then credited with his delivery, spoiled sheets being counted the same as perfect ones, so that if his return is correct his debit account on his passbook, which is kept in a totally different apartment and by other employees, is thus balanced. The finished impressions are now carefully counted and inspected. The spoiled ones are removed and sent to Government agents to be burnt, while the others are hung in the drying room. This apartment is heated by steam pipes, and the paper is suspended by wires, for a day or two, until perfectly dry. Then the brown paper is removed and the sheets, packed between leaves of press board, are subjected to the action of a powerful hydraulic press. They are then once more inspected and counted.

SCIENTIFIC AND PRACTICAL INFORMATION.

An esteemed correspondent, Mr. R. B. Forbes, of Boston, Mass., informs us that Mr. Herman Hirsch, whose screw propeller is used on the vessels of the Transatlantic Steamship Company, plying between New York and Havre (France), and has also been adopted by the British Admiralty, has recently discovered the form of least resistance in vessels. Almost every ship that has been built hitherto has been an attempt to solve the problem, and it has seemed that only by trying every possible form could it be ascertained which is the best. Mr. Hirsch is confident that he has succeeded by a scientific process in determining the theoretically perfect lines for a ship, and he will soon lay his plans before shipbuilders and owners. The scientific world will look with interest for the development of the system, especially as it comes from an inventor already successful and renowned.

HOW TO PRESERVE VINEGAR.

Our correspondent "Expert" writes as follows: "This article being the product of three well known chemical fermentative processes, known as the vinous or spirituous, acetous, and putrefactive: into each of which dilute saccharine or starchy solutions pass with great rapidity, under favorable circumstances, it is not exactly correct to attribute the latter process to the "mother" which is formed on good vinegar exposed to the air.

Vinegar makers should never keep their product in open vats or tanks. It ought to be passed from one generator to another till it is strong enough for a fluid ounce to saturate from 33 to 35 grains of crystalized bicarbonate of potassa, when it ought immediately to be run into casks or barrels, in the warm vinegar house kept at a temperature of 85° to 90°; and after filling the casks up to the bung, it should be sealed up tight and covered with a tin cap.

To prevent vinegar from running into the putrefactive fermentation, it is commercial usage to add one ounce of sulphuric acid to 100 gallons. This should not be added until the article possesses the required acetous strength, and is intended to destroy any putrefactive spores which may be present. British standard vinegar is said to have one part of dilute sulphuric acid in every 1,000 parts of vinegar, and this proportion is not regarded as an adulteration or injury in any way.

In general, the presence of mother in the vinegar is not considered objectionable. On the contrary, in domestic use its formation is promoted by using sheets of brown paper, etc. It is the "vinegar plant," about which so much was said, a few years ago, in the papers. Depending, for its existence, on the presence of oxygen, nothing is easier than to prevent its formation by carefully excluding the air.

The presence of mucilaginous matter so affects the specific gravity of the article that no test, by any scale, will prove or show its strength. The only proper method is occasionally to saturate a portion with potassa, using litmus paper to ascertain the degree of saturation."

A FISH SAVINGS' BANK.

There is, in Siberia, a district where the chief wealth and means of subsistence of the people consist of dried salmon; and to obviate the evils arising from an occasional dearth of food, the Russian government has established a savings' bank, with a capital of 300,000 fish. In this institution, every male inhabitant is compelled to deposit one tenth of all the fish he catches so long as the takes are up to the average; but if the yield fails, the contributors are entitled to withdraw their deposits.

ALL three of the Atlantic telegraph cables are now in perfect working order. We hope that the icebergs will not trouble them this winter.