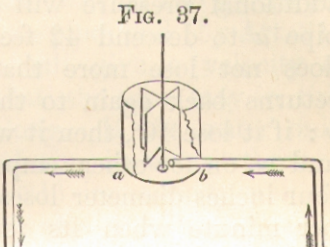
(136.) Eckstein and Busby's Patent Circulator, or Rotary Float, is an invention by which *centrifugal force* is made to overcome the *force of gravity*, in the circulation of hot water.* The boiler, which is either open or closed at the top, has a pipe, *a*, attached to its circumference, which is carried in any direction, either downwards, or around the room to be warmed, and finally returns into the boiler, and ends exactly in its centre, as shown at *b* in the annexed figure.

Fig. 37.



The float, or circulator, has motion given to it by means of a fly, similar to a smoke-jack, which is placed in the chimney, and is turned by the smoke of the fire that is used to heat the boiler, the float being fixed on centres, and revolving freely in the boiler. The centrifugal force imparted to the water by the rapid rotation of this float causes it to rise higher at the periphery than in the centre of the boiler; and the velocity with which the float moves determines the extent of this deviation from the level. The end of the pipe *b*, being *in the centre*, is then under a less pressure or head of water than the pipe *a*, the former being, by its position, removed from the greater pressure at the sides, which is caused by the centrifugal force imparted to the water by the float, which acts on the pipe *a* placed at the circumference.

* *Repertory of Arts, &c.*, vol. xiv. (1832), p. 137.

(137.) Suppose now the velocity of rotation to be such as to impart a centrifugal force sufficient to raise the water *one inch* higher at the circumference than in the centre, there will then be a pressure of 246½ grains per square inch upon the pipe *a* more than upon the pipe *b*, supposing the temperature of the water be about 180°. This additional pressure will allow the water in the pipe *a* to descend 42 feet below the boiler, if it does not lose more than 6° of heat before it returns back again to the boiler through the pipe *b*: if it lose 10°, then it will only descend 25½ feet, and so on for other temperatures. Now, as a pipe four inches diameter loses ·817 of a degree of heat per minute when its temperature is 120° above that of the room (Art. 270), this pipe may be of as great a length as the distance through which the water will flow in seven minutes and a half in the first case, or twelve minutes in the second.

(138.) The length of pipe through which the water will circulate in the above-mentioned times will depend upon the depth to which it descends below the boiler. In this apparatus, the shorter the distance through which the water flows, the greater is the rapidity of circulation—an effect which is the reverse of what occurs in the common form of hot-water apparatus. In general, the circulation is here very rapid; but the distance through which the water will travel is more limited than with the common plan of circulation. For, suppose the water to be raised by the centrifugal force one inch higher at the periphery than at the centre of the boiler, and that it descends 42 feet; if the water in the pipe lose six degrees of heat during its transit, the circulation will then be extremely slow; because, by the Table (Art. 15) we find that the difference of weight between two columns of water 42 feet high, and six degrees

difference of temperature, is 242 grains per square inch on the area of the pipe; and this is within *four grains* of the additional weight which the centrifugal force produces, under these circumstances, at the side of the boiler. But if the difference between the temperature of the two pipes be only four degrees, then the difference between the weight of the two columns will be 160 grains per square inch of the area of the pipe; and (by Art. 21) we shall find that this will give a velocity of 81 feet per minute, so that the pipe may in this case be about 400 feet long. If the water only lose three degrees of heat during its transit through the pipes, then (by Art. 21) its velocity will be 100 feet per minute, provided it descends only 42 feet below the boiler; and therefore, the pipe may be about 350 feet in length. If the depth of the descent below the boiler be only one half the amount above-mentioned, or 21 feet instead of 42, then the length of pipe through which the water will circulate will be just double the amount that has been stated for the several differences of temperature.*

These calculations are all made for pipes of four inches diameter; but if smaller pipes be used, the distance through which the water will circulate will be less, because, as the quantity of heat lost in a given time by different sized pipes is *as the inverse of their diameters*, so also will be the distance that the water will flow, if the velocity of its motion be the same.†

* This being exclusive of friction, the actual length of pipe will be less than is here calculated.

† It will be observed, from what has been stated respecting the common plan of circulation, that the whole of these effects are exactly the reverse of what there occurs. In that, the greater the difference of temperature between the pipes, the more rapid the circulation: in this, the circulation is more

(139.) If greater velocity be given to the fly-wheel and float, the centrifugal force and the height of the water at the circumference of the boiler will both be increased ; and the distances to which the pipes can be carried may then likewise be extended.

(140.) By using a close boiler instead of an open one, a range of pipes may be taken upwards which will act on the common plan of circulation, while another range of pipes may proceed from the bottom, and act on the principle which has here been explained. In this case, the centrifugal force, of which the additional height at the circumference of the boiler is merely the index or measure of effect, will still be of equal power, provided the velocity of the float continues the same ; and the water will therefore descend to the same extent as before. The spindle of the float must, in this latter case, pass through a stuffing-box on the top of the boiler, or some other contrivance to answer the same purpose must be adopted.

This invention, which is a happy application of dynamical principles to overcome one of the most constant of Nature's laws, by the development of an antagonist force, has hitherto been but little used. It is, however, clearly capable of being applied in cases where the same object cannot be accomplished by any of the more simple means which have been previously described.