er, I, Figs. 10 and 11, also electrically insulated from the frame, holds a spring arm, *h*, Fig. 10, which rests on a circuit breaker, *i*. The operation of this arrangement is such that, when the arm, *h*, rests on the non-conducting portion of the circuit breaker, no current can traverse the links of the magnet, but, when the conducting part, *m*, comes in contact with the arm, *h*, a circuit is made, and the armature made to rotate during the contact. Having thus described the mechanical details of the application of the sector magnet to the production of rotary motion, we will proceed to describe the mode of utilizing the reflex currents. Referring to Fig. 10, and considering the armature to be revolving in the direction of the arrow, and supposing that the circuit breaker is so adjusted, with reference to the arm, *h*, as to continue the action of the current till the axis of the magnet and armature are coincident, and then break, we should find that the reflex action of the current would resist any attempt of the armature to continue its onward motion, and this resistance is equivalent to seventy-five per cent of the battery current. But, if the adjustment of the circuit breaker be such that the current is broken previous to the coincidence of axis of the magnet and armature, then the reflex current, instead of retarding the motion of the armature, will expend itself in assisting its motion; therefore, in order to convert this reactionary property of the currents into a valuable element of force, the circuit breaker is adjusted under such conditions as will insure a break previous to the coincidence of the axis of the magnet and armature, as shown in Fig. 10, the dotted lines showing the position that the armature obtains through the action of the reflex currents, the break having been made when the armature was in the position shown by the full lines.

CLAIM.—First. The combination of the sector magnet, A, and sector limbed armature, F, with their adjustments or without. Second. The breaking of the circuit previous to the coincidence of the axis of magnet and armature, substantially in the manner specified.

Breweries and their Fittings.

A paper "On the Machinery and Utensils of a Brewery," was read before the Society of Engineers, in the hall of the Westminster Palace Hotel, London, by Mr. Thomas Wilkins, C.E.

The size of a brewery is stated in the number of quarters of malt that can be used in one brewing; thus, a brewery having a mash tun in which twenty combs of malt can be mashed at a brewing, would be a "ten quarter brewery," and so on, the rest of the plant being made in proportion.

Until steam came into general use as a motive power, all the labor was done by hand or horse power; sometimes a water wheel was used; but it is believed that on no occasion has wind power been applied. Of late years, steam has not only been used in breweries as a motive power, but also as a means of transmitting heat; so that the brewer having a boiler to supply steam to the engines, uses it also to supply steam for boiling both liquor and wort, either by forming the boiling coppers with an outer pan or jacket of iron, and passing steam through the space between that and the inner pan of the copper, or by passing the steam through coils of copper pipe fixed at the bottoms of vessels made of wood, iron, or copper, whichever of these be preferred.

In building a brewery every advantage should be taken of any favorable natural features of the locality, such as a hill side, where the building may be arranged so that the utensils can be placed in a position one above another in level, taking advantage of the natural slope to save labor, which might otherwise have to be expended in pumping the worts or beer about. A good supply of suitable water, or "liquor," as it is called in breweries, is also indispensable. That there is this should always be ascertained before either building a new brewery or extending an old one.

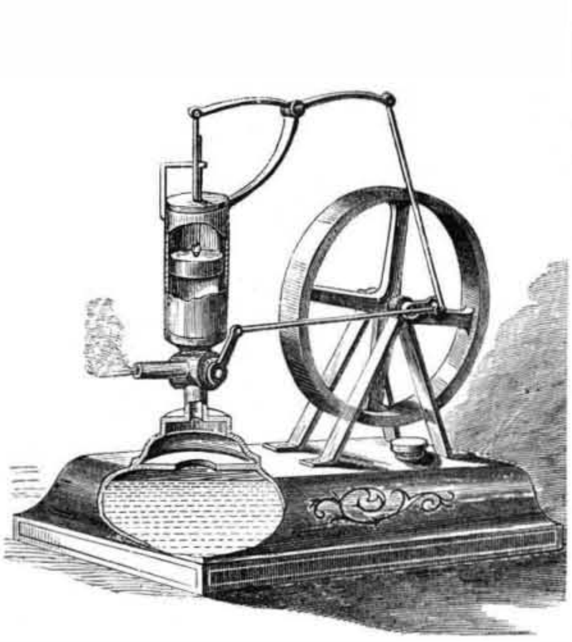
The mash tun should be made either of good yellow deals or of oak, and should have a false bottom, generally of iron, made of several plates, so as easily to be removed for cleansing the tun. These plates are very closely perforated with holes about one twelfth of an inch in diameter; sometimes, however, with slots that width, but about two inches to three inches long, cast in them. These slots and also the small holes are about three eighths of an inch on the bottom side of the plate, being made so much taper to prevent their blocking. The plates with slots are more expensive than the others, but some brewers prefer them. The mash tun should contain from eighteen to nineteen cubic feet for every quarter of malt. Formerly, when the crushed malt had been placed in the tun, the nearly boiling hot liquor was run in, and the whole was thoroughly mixed together by men with poles, each having several cross pieces, about the size of the staves of a ladder, in one end. This operation is termed mashing, and these oars are still used by some brewers, more especially where a "Steele's" or a similar machine is used.

A better and more certain method of mashing was required; for it was found that in some parts of the mash tun a sort of cake or dumpling would be formed, the outside of which, consisting of a pasty mass of flour, prevented the liquor reaching the inside, to extract the valuable ingredient of the malt. The machine which for many years has been fitted to mash tuns, to perform this operation, is made as follows: A circular crank, with radial teeth, is bolted to the sides of the mash tun; a vertical shaft is erected in bearings in the center of the tun. This shaft is either carried some few feet above the top of the tun, or else passes through a stuffing box in the bottom, and is worked by bevel wheels from a horizontal shaft. The vertical shaft supports loosely a bearing which carries one end of a second horizontal shaft, which is inside the tun, at about half its depth. The other end of this shaft has a pinion keyed upon it. This pinion gears with it, and is supported by the circular rack before mentioned. A revolving motion is given to this horizontal shaft by bevel wheels from the vertical one, and upon it is hung a sort of rake, which, as the shaft revolves, thoroughly mixes up the mash. Sometimes there are two, and even three of these rake shafts. It will be obvious that, as these shafts revolve, the pinion gearing into the fixed rack causes the whole to revolve somewhat slowly round the tun.

In large breweries, where there are sometimes a dozen or more mash tuns, rather than have a large engine, it is better to have a small one to pump all the liquor, and another to grind the malt; and these may be kept at work all day, preparing for the morrow. Indeed, a vast amount of money in first cost, and in labor afterwards, may be saved by properly planning and arranging everything beforehand.

TOY STEAM ENGINE.

This is a very simple and pretty toy engine, consisting of very few parts. It is the invention of Philander Macy, of Rochester, N. Y. It is a beam engine with oscillating valve



gear, and the pedestal upon which it stands is the boiler. By filling the boiler and setting it upon a stove, the engine will work as long as the water supply lasts.

Cracked Sovereigns.

It has probably fallen to the lot of many readers to have come into possession occasionally of gold or silver coins which were hollow, or cracked on their edges, and therefore not sonorous when tested by the well known "ringing" process. Speculations as to the source of the imperfection are numerous, and various theories have been advanced and discussed in regard to it.

Perhaps one of the most extensively prevailing notions as to the origin of cracked sovereigns and cracked coins of other denominations, is, that all pieces of money fabricated at the British mint are, in the first place, made in halves, the heads and the tails being afterwards paired and united by cementing, soldering, hydraulic pressure, or some other means. This operation being in some cases imperfectly performed (as it is argued), a partial or complete divorce may afterwards take place, and hence the phenomena of cracked moneys.

Another supposition is, that the hollow coins have been tampered with by gamblers for their own nefarious purposes. Neither of these theories, however ingenious they may be, is the correct one. The evil really arises in the way we shall attempt to describe. All the legitimate metallic money of this country is made from bars of cast gold, silver, or bronze. At the Royal mint there are orthodox sizes for these bars, so as to produce each variety of coin in use outside its walls. Those for sovereigns are twenty-six inches long, one and a half inches wide, and one inch thick; and, for the purpose of facilitating explanation, let us confine our attention to gold only.

Such bars are cast in vertical molds of iron, which latter are fitted together in halves, so as to allow the giant nuggets to be realized easily from within them. On filling a mold from the crucible of molten metal held over its mouth, the resulting bar cools rapidly. Those parts of the bar which touch the sides of the mold cool first, and more gradually the center is reduced in temperature. As the sides of the bar harden at once, they cling, as it were, to the walls of the mold, whilst the metal in the middle contracts in cooling, and subsides down the mold. The upper end of a bar of gold resembles much at this juncture the mercurial column in a barometer when the "glass" is said to be "falling." It is hollow or depressed in the middle, and sometimes very much so, the depression occasionally extending to one inch.

The lower end of the bar is perfectly squared, because the base of the mold is square. When removed from its iron case, the bar is carried to the rolling mill for lamination. It is passed again and again between the rollers, until it is attenuated into a strap or ribbon; but that which was its upper end is still defective. The rollers have simply compressed the precious metal, and therefore left the hollow end a mere crevice or thin line in the middle of the strap. This end is considered as scrap, and, first cut off by a pair of shears, it is returned to the melting pot. It happens, sometimes, nevertheless, that a sufficient portion of imperfect ribbon is not cut away, the crack thus extending beyond the amputating point. When this occurs, it creates the evil of "cracked sovereigns." The ribbon is removed to the punch ing press, and perforated from end to end by a punch of the exact size of a sovereign. Some of the disks of metal thus produced *may* be cut from the bad end of the strip of gold. To detect these criminals, if they exist, a small staff of boys is employed. They are each armed with a bright-faced anvil block of cast iron, and they ring every individual disk in very rapid succession on the anvil. The sound and perfect pieces give forth harmonious music, whilst the others are dumb dogs, and have no music in their souls. The defaulters are, or should be, all picked out, and condemned to the "fiery furnace" once more. Boys are not infallible, and they have permitted "dummies" to escape now and then. These pass forward to be stamped at the presses, milled on their edges, and issued to the public, by whom they are criticised, and justly condemned. The hollowness of their characters is only detected, it may be, after some contact and friction with their neighbors, just as speciousness in the human character is only found out by the application of the tests of adversity and trouble. With the care at present exercised at the mint, hollow coins cannot escape detection.

Correspondence.

The Editors are not responsible for the opinions expressed by their Correspondents.

Utilizing Coal Dust for Fuel.

MESSRS. EDITORS:—Bringing into practical use the coal dust or slack coal, is today the great question; and as you have given space in your columns to a great many communications on the subject, will you do me the favor to insert this letter on the manufacture of artificial fuel or compressed coal dust?

It is a well known fact that coal, either bituminous or anthracite, produces in mining, breaking, screening and handling, an amount of dust, commonly known as slack coal, amounting, on an average, to 50 per cent of the coal production, thus causing a considerable loss to the parties engaged in mining, as but a small portion of this dust coal, and that only of the bituminous coal, is needed for blacksmith purposes, while the anthracite slack is entirely useless. The immense quantity of refuse coal must necessarily be got out of the way, whether dumped into a stream, to be carried off, or heaped on ground which has to be dearly paid for.

In the anthracite coal regions, this immense amount of waste is constantly being piled up around the mines in vast, unsightly mounds, burying the mining villages, and sadly encroaching on the limits of many of the chief towns. The amount of this waste cannot be less than fifteen millions of tuns, and every year adds to the rapidly increasing dirt bank.

In France, in Germany, in Belgium, and in England, the slack of the bituminous coal has been converted into lumps or cakes of different sizes and shapes by mixing it with coal tar. Monsieur Dehaynin, from Paris, started the first manufacture of artificial fuel or agglomerated slack, at Montigny-sur-Sambre (Belgium) about eleven years ago. He possesses today two manufacturies in Belgium and two in France. He manufactured in 1870 over 1,200,000 of tuns; railroad companies used 931,600 tuns, the navy used 250,000 tuns, and other industries used 70,000 tuns.

Among the railroad companies, that of the Paris, Lyons, and Mediterranean consumes pressed coal exclusively, requiring 1,200 tuns per day. The Northern Railroad Company, of France, between Paris, Amiens, Dunkerque, and Calais, does not use pressed coal exclusively, although its daily consumption amounts to 300 tuns. The scarcity of coal tar is the only thing which prevents M. Dehaynin from erecting other factories and increasing the manufacture of his compressed coal.

It will be observed that the railroad companies and the navy are using almost exclusively compressed coal, while private manufacturers do not seem to like it. The reason is that the burning of that coal produces such a smoke and such a bad smell that it is entirely unfit for domestic use, and cannot even be used in stationary engines, people in the neighborhood complaining of the nuisance. It was only permitted to be used in some sugar refineries and distilleries, situated at a reasonable distance from cities; and even then the law compelled the proprietors of those manufactures to raise their stacks to a specified hight.

So important has this subject of converting coal dust into lump coal been regarded, that the United States Commissioners, to the Paris exposition of 1867, have made a report on pressed or agglomerated coal, which presents the subject and its importance in an able and instructive manner.

That report sets down among the advantages attending the use of pressed coal, the following:

"Its purity and compactness adapts it to the rapid production of steam in furnaces and small fire grates, and it is, therefore, a desirable fuel for steamers and locomotives, for which it is largely used in Europe.

"Being manufactured in prismatic form, it can be very compactly stored on shipboard or elsewhere.

"It can readily be transported to great distances with very little waste, amounting, it is stated, to less than one tenth the waste of ordinary coal, handled under similar circumstances.

"It is not injured by frost, by snow, or by rain. Bricks of pressed coal produce as much steam in locomotives as an equal weight of coke. It is much liked by firemen, especially for raising steam in ascending heavy grades.

"Soft bituminous coal, or the mixture in which it predominates, is generally used in the manufacture of pressed coal."