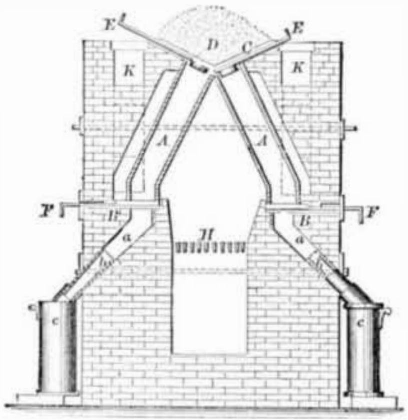
APPARATUS USED IN INDUSTRIAL PROCESSES.

Our extracts this week from Knight's "New Mechanical Dictionary" include apparatus of various kinds employed in several industrial processes. Fig. 1 is a

BONE BLACK FURNACE,

used for revivifying bone black for the purification and de colorization of saccharine solutions. The bone black, D,

Fig. 1.



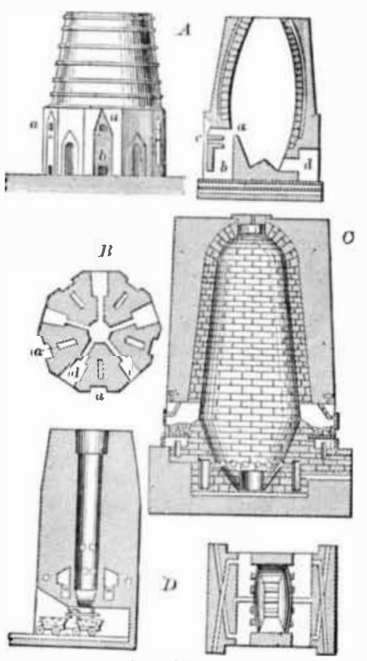
Bone-Black Furnace.

charged with impurities, is deposited in the hopper, C, where the withdrawal of slides, E, permits it to fall into the tubes, A, which are exposed to the heat from the grate, H, until the impurities are discharged. Then, by withdrawing the slides, F, on the bottom plates, B, it passes into the tubes, *a b*, and is received in vessels, *c*. At K are flues for conducting off the products of combustion and partially drying the black before it is admitted to the tubes, A. The process of

LIME BURNING

consists in calcining the carbonate in the form of limestone in kilns, during which the carbonic acid is driven off, leaving oxide of calcium or quicklime. Fig. 2 represents various forms of kilns. A B represents the kiln used at Ruders dorf, Prussia, and adapted to burn one part wood to four of turf. It has five fireplaces, *a*; *b* is the ash pit; *c c* are openings for regulating the draft, and at *d* are apertures for withdrawing the lime. The kiln is lined with a double thickness of fire bricks, the space between which and the outer masonry is filled in with well rammed cinders to prevent loss of heat. In the kiln, C, blasts of air are forced through the burnt and cooling lime, and mingle with the

Fig. 2.



Lime-Kilns.

hot currents from the furnaces. The latter are placed around the kiln, and air blasts are driven through the fuel. The upper end of the kiln is arched over, and the feed hole has a removable cover. The kiln, D, has bottom discharge, and the furnaces arranged on each side connect with it. A cross arrangement of flues counteracts irregularities of draft on the windward and leeward sides. Fig. 3 is a form of

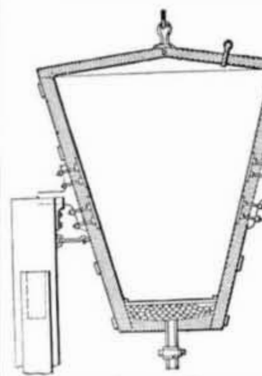
LEACHING VAT,

used in the process of chlorinating gold It is made of two inch plank, and is pitched inside. Lead discharge cocks are placed at the bottom; and under the false bottom, which is fastened so that it will remain in place when the vat is overturned, pieces of quartz are loosely laid. A pipe inserted into the airtight lids leads the chlorine gas from one vat to another of a series. The vat, before the admission of gas, is charged with the auriferous material. After the gold is dissolved, water is admitted, carrying off the chloride of gold to a vat, When the ore is thoroughly leached, it is discharged into a car and removed outside the works. Another process for the extraction of gold or silver from comminuted ore is conducted by exposing the material to molten lead' with which it forms an alloy. The apparatus is

THE LEAD BATH.

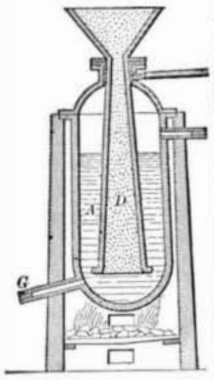
In the form represented in Fig. 4, the ore occupying the

Fig. 3.



Leaching- Vat.

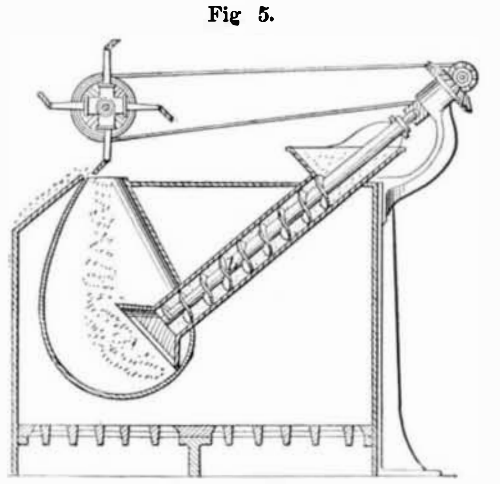
Fig. 4.



Lead-Bath for Precious Ores.

central shaft, D, is discharged beneath the column of lead, A, which is kept molten by the furnace beneath. The heavier portions of the alloy are drawn off by the pipe, G. The ore rises through the lead, bringing the particles of precious metal in contact therewith. The flow of ore is assisted by withdrawing air from above by an air pump. In Rose's lead bath, Fig. 5, the vessel is suspended in a furnace,

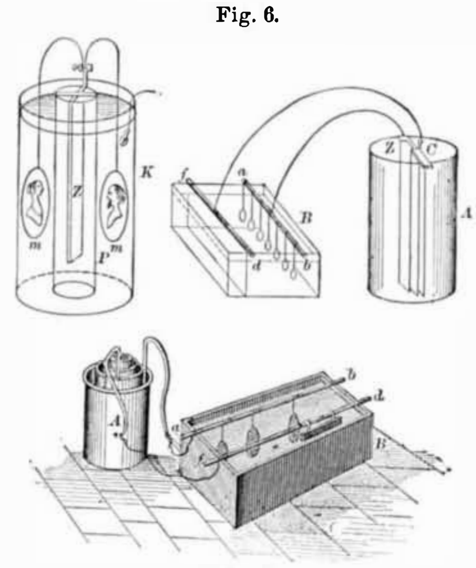
Fig 5.



Rose's Lead- Bath.

through which extends an inclined tube which discharges its contents near the bottom. The tube has a propelling screw, with a shoulder and elastic collar at its bearing, and a grinding plate at its lower end, which works against a grinding surface. Above the mouth of the vessel is a wheel which removes the waste ore as it rises to the surface of the

Fig. 6.



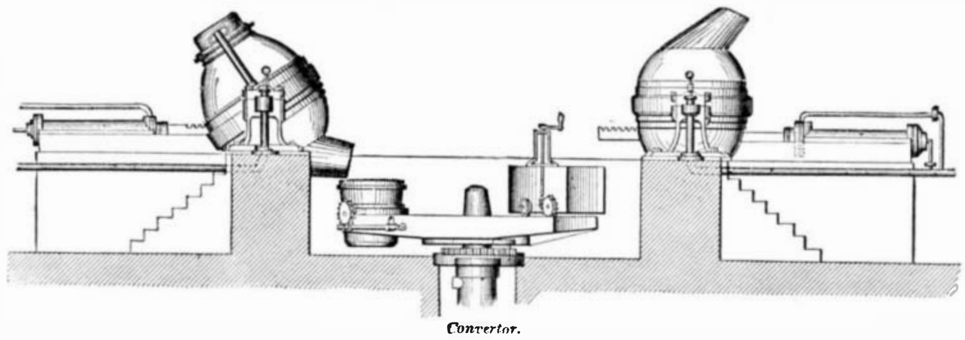
Electro-Plating Apparatus.

molten lead. Fig. 6 represents the apparatus commonly employed in

ELECTROPLATING.

A is the battery, and B the vessel into which the solution of the metal to be deposited is placed. The molds are suspended from a metallic rod, *a b*, opposite to which the plate, *f d*, is hung. Copper, if the solution be of a salt of that metal, serves as a soluble electrode, and is dissolved in the same ratio as the metal is deposited upon the mold. The battery being charged, *f d* is put in communication with the copper pole, C, by a copper wire, and *a b* is connected with the zinc pole, Z. The current produces decomposition, and the electro-positive metal is deposited on the object attached to the negative pole.

Fig. 7.

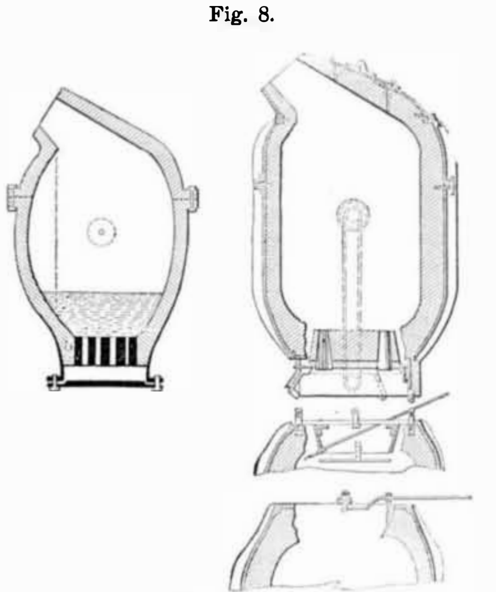


Convertor.

THE CONVERTERS

used in steel making are represented in Figs. 7 and 8. The

Fig. 8.



Holley's Convertor.

five-tun converter is an iron vessel, 14¼ feet high and 9 feet in diameter externally, of a bulbous shape, and hung upon trunnions. The lower hemisphere is truncated, giving a flat bottom, five or six feet in diameter. The upper hemisphere terminates in a large neck inclined sidewise, so that a flame issuing under pressure from the mouth of the upright converter is obliquely directed into a chimney, guarded by a hood. The whole vessel has a rude resemblance to a pear. It is supported by heavy trunnions on each side of the center, and revolved upon these by hydraulic power.

This huge iron bottle, with its neck awry, is lined with a foot of refractory material, known as ganister, to preserve the iron shell. The trunnion is hollow, and a passage from it runs down the outside, looking like a strong rib in the iron surface, to the bottom, where it communicates with the tweers. The bottom of the Holley converter is movable, and when taken out looks like a great plug of fire brick, two feet high, resting upon a cast iron disk. The tweers, or nozzles for the blast, are imbedded vertically in the lining, and present ten groups, each containing a dozen three-eighth inch holes. The aggregate area of these openings is equal to that of a single tweer 4·1 inches in diameter; but the thorough agitation produced by dividing the blast secures much greater useful effect. The pressure of the blast is twenty-five pounds per square inch.

The converter in its upright position, being heated by a charge of coals and the blast, is turned mouth downward to vomit out the glowing coals, then upon its side to receive its charge, which runs from the cupola furnace above, along a trough, and plunges into the mouth of the converter. The position of the retort as this time prevents the charge from running into the tweers before the blast begins. Afterwards the pressure of the air itself keeps the passages clear. Then the blast is let on, and the converter swung back to a vertical position. A tongue of white flame comes roaring out of the mouth. The silicon of the pig oxidizes first, without very intense flame; but as the graphite and especially the combined carbon begin to burn also, the heat rises to some 5,000° Fah., and the light is so brilliant as to cast shadows across full sunshine.

In fifteen or twenty minutes the marvelous illumination ceases more suddenly than it began. The volume and brilliancy of the flames diminish together with startling rapidity. This change of the Bessemer flame marks the elimination of most of the carbon, and indicates the critical moment. When it arrives, the blast is stopped, the converter is turned upon its side, and 600 pounds of melted spiegeleisen are turned into it, as the pig was previously charged. The reaction is instant and violent. The manganese of the spiegeleisen combines with any sulphur that may remain in the bath, forming compounds which pass into the slag. It also decomposes, in the slag, silicates of iron, taking the place of the iron and returning it to the bath. Finally, the carbon and manganese together reduce the oxide of iron formed during blowing, which would destroy the malleability of the iron. This is quickly accomplished, and now the gigantic converter, like a monster weary of drinking boiling iron and snorting fire, turns its mouth downward, and discharges its contents into a vast kettle or ladle, brought underneath for the purpose by one of those intelligent cranes that stand around, so silent and so helpful. The ladle is swung over the molds ranged round the side of the semicircular pit below, like a row of Ali Baba's oil jars, each capable of containing a bandit. The white, one would almost say transparent, metal is drawn off into these through a tap hole in the bottom of the ladle, retaining the slag which floats on the surface till the last. When the first mold is filled, the plug is closed, the ladle swung round to the second mold, and so on till all the steel is thus cast into ingots, the size of which varies with the kind of work for which the steel is required. A thin

---

*Published in numbers, by Messrs. Hurd & Houghton, New York city.

© 1876 SCIENTIFIC AMERICAN, INC.

steel plate is placed on the top of each casting immediately the mold is filled, and over this a bed of sand is placed, and speedily and firmly pressed down.

As soon as the ingots have solidified, and while they are still glowing, the molds are lifted off them by means of an hydraulic crane, and afterwards the ingots are picked up by tongs attached to the same machinery, and are carted away, all red hot, to the hammer shops, where they are thumped and rolled or otherwise tortured into their required forms of rails, tires, and plates.

Correspondence.

The Inverse Rotation of the Radiometer an Effect of Electricity.

To the Editor of the Scientific American:

In a former communication to the SCIENTIFIC AMERICAN, I endeavored to show that the direct rotation of the radiometer was an effect of electricity. Before attempting to explain the inverse rotation, it will be necessary to state briefly some new facts which my electroscopic researches have led me to establish.

In order to ascertain the electric state of their inner surfaces, I exposed, to solar radiation, glass receivers such as are used for the air pump. By means of the proof plane and electroscope, I found that this surface was electrified negatively, and even to a greater degree than the exterior. This excess of energy I attribute to the numerous reflections from the interior. If, however, we hold one of these electrified receivers near the Böhnenberger electroscope, taking care that it does not come in contact with it, the electroscope at once indicates the presence of positive electricity. As both the outer and inner surfaces are negatively electrified, this phenomenon must be attributed to the electricity developed in the interior of the glass itself by its molecular polarization and feeble conductivity. The following experiment confirms this explanation If we remove from the exterior, by means of the proof plane, a portion of the negative electricity, and then approach, as before, the globe to the electroscope, a remarkable increase of positive electricity is at once shown. The same results are observed in the radiometer.

I next examined the electric state of the exterior of the radiometer globe when placed in partial obscurity and moistened with ether. There are no signs whatever of electricity, as long as the inverse rotation continues; but as soon as the direct rotation commences—on account of the obscure radiations given forth by the surrounding bodies—positive electricity manifests itself and rapidly increases. While in this state, I exposed the radiometer to solar radiation, and I found that this positive electricity remains quite a long time, and that, notwithstanding the positive charge on the exterior, the direct rotation continues with its usual rapidity.

The fact last mentioned enabled me to determine by experiment the electric state of the inner surface of the radiometer globe. Only two suppositions can be made in regard to it: either the electric state of the inner surface is dependent, by means of molecular polarization, upon the electric state of the exterior, or it is independent. In the first supposition the interior face is electrified positively when the exterior is electrified negatively, and *vice versâ*. The second supposition may be divided into three hypotheses, for we can admit that the interior is constantly, under the same circumstances, either neutral, or negative, or positive. Hence we have in all four hypotheses, *à priori*, namely: 1. Inner surface is dependent upon electric state of exterior. 2. Inner surface is independent and neutral. 3. Inner surface is independent and negative. 4. Inner surface is independent and positive.

Now of these four hypotheses, the fourth alone is verified by experiment. This I have established as follows: In one series of experiments I charged the exterior of the radiometer with positive electricity by exposing it to solar radiation. In a second series I charged the same surface with positive electricity by exposing it to solar radiation after moistening it with ether. Each experiment comprised two operations. I touched a certain number of times the exterior of the glass globe with the proof plane, and I carefully observed the electroscopic signs of the Böhnenberger electroscope when brought in contact with the proof plane; then I approached to the electrometer the glass globe which had been partially discharged by the preceding experiment, and I again observed the signs given by the electroscope. In the case that one of the first two hypotheses expresses the real state of the inner surface of the radiometer under the influence of radiation, on approaching the glass globe we should have, in both series of experiments, electroscopic signs of equal intensity for equal electric changes of the exterior surface, manifested by the equality of those of the proof plane. Now this does not take place. In my experiments on the approach of the globe, the electroscopic signs in the second series surpass in intensity those observed in the first series. These results agree perfectly with the fourth hypothesis, but are in open disagreement with the third. Any one can easily see this, with a little attention, by considering the layers of electricity produced in the interior of the glass walls by molecular polarization. The fourth hypothesis is, then, the true one, and the inner surface is electrified positively.

The explanation of both the direct and inverse rotation follows naturally from these facts and those communicated in my former note. For, since the inner surface, when exposed to luminous or calorific radiations, is electrified positively, the direct rotation is a necessary consequence of the attractions and repulsions which this positive electricity exerts upon the free electricity of the vanes. This rotation continues when the radiometer is surrounded by light, because a perfectly homogeneous layer of electricity upon the inner surface is almost impossible.

The inverse rotation occurs in two circumstances: 1. When the instrument, having been exposed to radiation which produces a direct rotation, is allowed to cool slowly. 2. When the radiometer at the ordinary temperature is cooled suddenly, for instance, by moistening it with ether.

In the first case, the electricity, which the globe acquires when exposed to radiation, disappearing very slowly, as experiments show, an inversion of the movement can be produced by an inversion in the signs of the electricity of the vanes. In fact, in accordance with the principle of reciprocity, the emission of the radiations gives rise in the vanes to a development of electricity equivalent and contrary to that which absorption has produced there. By this development of electricity, the vanes would return to their neutral state if the electricity produced by absorption had not passed in part from the vanes into the rarefied gas of the globe. Now this passage took place with a greater energy as the rotary movement of the vanes had renewed more frequently the mass of air in contact with them. Hence the electric effect of the emission will be to change the signs and to diminish the charge of free electricity of the vanes. In the second case, where the cooling is produced by moistening the exterior, the globe remains in its neutral state. For, as I have above remarked, during the whole time of the inverse rotation the cooled surface of the globe gives no sign of electricity. It appears that the cooling itself is not capable of producing electricity, but that the passage of a radiation through the surface is absolutely required. In these conditions, the vanes become charged with negative electricity upon the dark, and positive electricity upon the bright, side, by reason of the emission, at the same time that the radiations, given forth by the vanes and absorbed by the inner surface of the glass globe, electrify the latter positively. Thus the electric theory of the radiometer explains quite well the principal phenomena which have been observed up to the present time. I hope to make, hereafter, a study of all the particular movements which different observers have published in the *compte rendu* of their experiments. I will only say now that the most remarkable of them, namely, the rotation of the radiometer globe when an obstacle is put to the rotation of the vanes, as discovered by Schüster, is in entire conformity with the above theory, while it constitutes a very serious objection to the hypothesis of mechanical impulsion by radiation. JOSEPH DELSAULX, S. J.

11 Rue des Récollets, Louvain, Belgium.

Petroleum as a Lightning Conductor.

The destruction of oil by lightning this year has been remarkable, amounting to 242,412 barrels, from January 1 to July 31 of this year, or rather from April to August; there were no fires from this cause in January, February, or March, two in April, none in May, four in June, and five in July. It is scarcely necessary to inform our readers that the oil destroyed is in closed-top iron tanks, and the lightning, striking these, explodes the gas that collects in the space above the oil, scatters the oil, and sets it on fire, and in this way often communicates to other tanks in the immediate vicinity. The theory most commonly received in the oil regions of the cause of such frequent lightning strikes is that the gas, which, it is well known, is continually escaping from the oil in these tanks, rises to some distance above the tanks, acts as a conductor, attracts the lightning, and the damage is done. One peculiar feature in the history of these accidents is, so far as we have been able to learn, no iron-topped tank has been struck, but in every case wooden-topped ones. We have made special inquiries on this point with the uniform result given. So far, attempts to protect tanks with lightning rods have been failures; at Dilks' Station, a number of rods, supposed to be ample protection, were placed about the tanks, but they were no protection against this summer's bolts. It may be interesting, to those not acquainted with the oil business, to state that, in losses occurring in this way, all the oil in the pipe line to which the tanks belong is assessed *pro rata* for the loss; that is, the law of general average, so well known in marine law, is applied in this case.—*Stowell's Petroleum Reporter*.

REMARKS:—If it were possible to carry the rods entirely above the rising gas, then the rods would be a complete protection. But the probabilities are that the rods mentioned were either immersed in an atmosphere of explosive gas, which the lightning necessarily ignited before it reached the rods, or the rods, like the majority that are put up, were not properly connected with the earth, consequently could not protect anything. A lightning rod not sufficiently joined to the earth is of no more use in conducting lightning than is a pipe with one end stopped up to conduct water.

We wish that some of our readers would give us the particulars of the rods at Dilks, describing especially the nature of the ground connections.

Explosive Agriculture---Dynamite vs. Plows.

The agents of M. Nobel, the well known inventor of nitroglycerin, have lately found a novel use for dynamite in grape culture, which suggests further possibilities. The explosive was not used for its chemical effect, but in a purely mechanical way, literally to "shake up" the earth and allow the free percolation of water and the access of air to the roots of the vines. To this end holes were made in the soil about ten feet in depth, and at points where no roots of the vines were likely to be injured. Then cartridges of dynamite were introduced and exploded, and the result was that, for the entire depth noted, the earth was made loose and friable. The ground, in short, was not only rendered in better condition than could have been effected by plow and harrow; but every phylloxera, so the writer says, on roots of the vines was killed. The quantity of dynamite used is not stated, but it is likely to have been but small, just enough to shake the soil without blowing up the vines.

It seems to us that the use of dynamite in agricultural operations need not stop here. Instead of breaking up old pasture lands with the plow with great labor, the farmer might bore holes here and there, drop dynamite cartridges, blow them up, and in a second find his soil loosened and all noxious worms and insects therein destroyed. Dynamite, however, is a dangerous material, and hardly one of which to counsel the indiscriminate use; but nevertheless it might prove a profitable venture for engineers and powder and nitro-glycerin manufacturers, and others who may safely and lawfully be trusted with the explosive, to offer their services in breaking up land for farmers.

PRACTICAL MECHANISM.

BY JOSHUA ROSE.

SECOND SERIES—Number XII.

PATTERN MAKING.

We may now commence a series of examples, accompanying each example with the explanations and considerations necessary to, and governing the method of, the construction chosen. Fig. 86 represents a drawing of a gland for which a pattern is required. Now this is a very simple pattern, and yet there are at least six different methods of making it, any of which may be followed, as will appear more clearly to the reader by his glancing over Figs. 87, 89, 90, 92, 93, and 94. The first question is how to determine which method is the most suitable. Let us suppose the pattern maker to be uninformed of the purpose the casting is to serve, or how it is to be treated: in such a case he is guided partly by his knowledge of the use of such patterns, and a consideration of being on the safe side. The form shown in Fig. 87 would suggest itself as being a very ready method of making the pattern; by coring out the hole, it can be made parallel, which the drawing seems to require. The advantage of leaving the hole parallel is that less metal will require to be left for boring, in case it should be necessary; because, if the hole is made taper, the largest end of the bore will require to have the proper amount of allowance to leave metal sufficient to allow the hole to be bored out true, and the smaller end would, therefore, have more than the necessary amount: while just the least taper given to the exterior would enable the molder to withdraw the pattern from the mold. Made in this way, it would be molded as shown in Fig. 88, with the flange uppermost, because almost the whole of the pattern would be imbedded in the lower part of the flask, the top core print being all that would be contained in the cope; and even this may be omitted if the hole requires to be bored, since the lower core print will hold the core sufficiently secure in small work, unless the core is required to be very true. The parting of the mold (at C D, in Fig. 88) being level with the top face of the flange, much taper should be given to the top print (as shown in Fig. 87), so that the cope may be lifted off easily. Were this, however, the only reason, we might make the top print like the bottom one, providing we left it on loose,

Fig. 86.

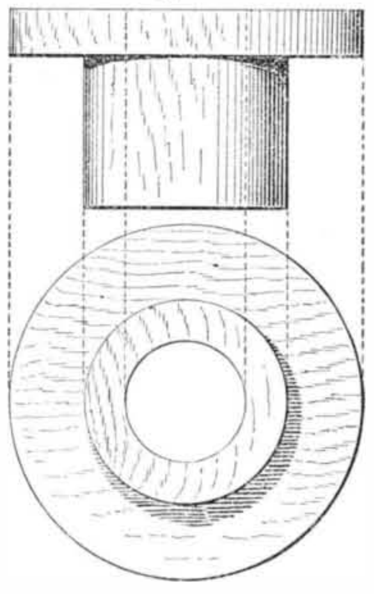
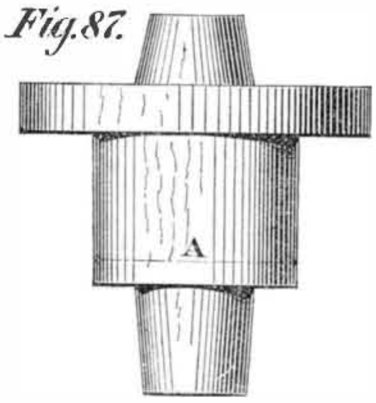


Fig. 87.



© 1876 SCIENTIFIC AMERICAN, INC.