THE ACCIDENT TO THE STEAMER CITY OF PARIS.

The accident to the machinery of the great steamer City of Paris, which took place on March 25 last at sea, off the coast of Ireland, on her outward voyage from New York, has occasioned much comment and inquiry in engineering circles. The wreck of the great engine, 10,000 h. p., was complete. Almost in an instant it was transformed from an organized and beautifully working system into a chaotic jumble of bent and distorted fragments.

The first and apparently most correct reason given for the accident was the breaking of the propeller shaft, the sudden fracture of which was supposed to have produced a racing of the engine, by which it was torn to flinders. The cause of the breaking of the shaft was said to be due to the wearing of its outer bearings. *Engineering* gives a detailed explanation, from which we give a few brief extracts, with an engraving:

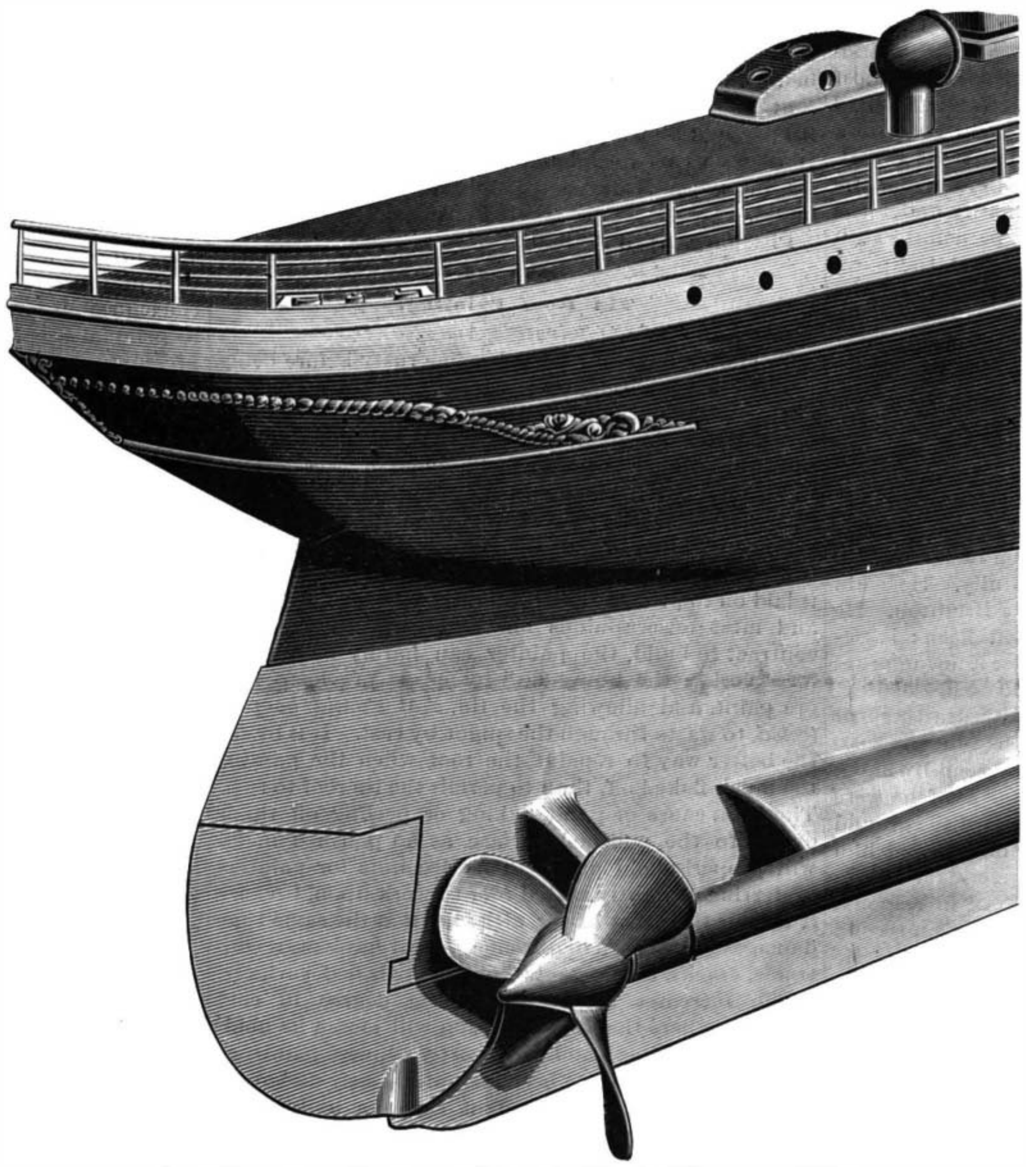
Each of the twin shafts passes through the ship's side through a stern tube in the usual manner. Immediately outside there is a flange coupling of the ordinary description, by which attachment is made to the outboard length of shafting. It was immediately on the forward part of this coupling, and therefore directly outside the stern tube, that the starboard shaft was broken square across. The position of this fracture is not shown in our engraving, it being somewhat forward of the part illustrated. The diameter of this part of the shafting is 20¼ in. The fracture was thick with rust on both faces, but there was every appearance of the metal being sound throughout and of excellent quality. On the whole, we should judge the shaft to be an excellent job, and the fracture to be entirely unconnected with any fault in the material. The outboard portion of the shaft abaft the coupling just referred to consists, we may say, of one length of hollow shafting 42 ft. long, and one length of solid shaft 15 ft. long, this latter length carrying the propeller. The total length of shafting abaft of the point of fracture was thus some 58 ft. or so.

This breakage of the shaft will of course fully account for the racing of the engine, while the subsequent damage done thereby can, we think, also be fully accounted for by causes we shall explain. Proceeding aft in our examination of the vessel, we found the two arms of the stern bracket intact, their attachment to the vessel being undisturbed. At their outer ends they are, or rather were, connected by a cylindrical boss which forms the support in which the propeller shaft revolves as shown. This boss, with the two arms and their palms by which they are attached to the hull, form one steel casting in the usual way. The thickness of metal in the cylindrical part is 3½ in. This boss was fitted with the usual gun metal bush and lignum vitæ bearing strips. The cylindrical part of the casting was split clean across the top in a line with the axis. The reason of this was obvious; when the forward end of the broken shaft had commenced to fall, owing to losing the support of the casing, a twisting moment of considerable force was naturally exerted, and this the casting was unable to sustain. The length of the cylindrical part of the bracket is about 6 ft.

The top part of the bracket was split across when the twisting strain was brought upon it by the release of the forward end of the outside shafting when the casing was cast adrift in the dock. It should be stated that the fracture was quite bright and free from rust, showing that it had recently been made. It will be further evident that the cylindrical part of the casting could not be intact on its bottom side, or the shaft would not be released. There was, however, no occasion for any fracture to occur here throughout, and this brings us to the most interesting part of our report. The bottom part of the casting was worn through for nearly the whole of its length, and much reduced in thickness where not worn through. The metal liner, 1 in. thick, together with its end flanges, was also worn through, and was lying in the bottom of the dock. The brass sleeve of the propeller shaft had entirely disappeared, with the exception of two rings, presumably the collars at the end. The propeller shaft itself was practically undamaged, but the metal studs which attached the sleeve to the shaft were worn down level with the shaft, and the shaft was slightly worn also.

This wearing away and consequent dropping of the end of the outer shafting we take to be the obvious primary cause of the whole mischief.

We will now proceed to give some detailed account of the damage done inside the vessel, as revealed during our examination. Passing through the starboard engine room—not without risk of broken limbs as we scramble over the debris of the low pressure engine—we enter the dynamo room, which is placed immediately abaft the engine rooms, and thence proceed to the starboard tunnel. Here we find the shafting supported by four bearings, and in each case the caps have been broken off; but, so far as we could perceive by aid of a dim light, no damage had been done to the shaft. The brake strap lugs had been broken off, but there was no sign of more than ordinary wear upon the flange on which the strap engages. The journals of the shafting were also in good condition. At the transverse partition forming the forward end of the tunnel, the plating was torn and doubled up to a height of about 6 in. above the shafting. In the dynamo room, through which both port and starboard shafts pass, there are two bearings to each shaft; both of those belonging to the starboard shaft have their caps split. From what has been said it will be gathered that the shafting must have risen bodily when the accident occurred; but, as the stern tube is intact in its position, so far as our observation went, there must have been some bending of the shafting. The couplings of the various lengths have, however, stood the test.



STERN AND SCREW OF THE S.S. CITY OF PARIS.

The London *Engineer* gives a different theory respecting the cause of the accident, namely, it was due to the lifting of the screw shaft out of its bearings in the engine room; and the breaking of the shaft, which took place afterward, was occasioned by the momentum of the great propeller, on the sudden stoppage of the engine.

"We find," says the *Engineer*, "that the screw shaft was lifted up out of its bearings from end to end, and the lifting up has been of such a character as to prove that the lifting effort occurred in the engine room. The screw shaft is secured to the end of the crank shaft in the usual way by a cheese coupling and bolts. The crank and screw shafts were virtually all one from the forward end of the engine room to the stern tube. The cap bolts of the after bearings on the crank shaft, although 5 in. in diameter, are broken off short, but the cap bolts of the other bearings are intact. Proceeding aft, we find that the cap was torn off the thrust block and the horseshoes scattered about the engine room. From this, back to the stern tube, all the keeps were torn off, save the last. It is perfectly clear that the screw shaft was lifted up in the engine room, and that for the moment it was several inches higher in the engine room than it was at the stern tube. How, it will be asked, was it possible that the shaft could be so lifted, while the crank shaft to which it was secured remained tied down? The answer is curious, and yet simple. The crank shaft is built up. Let us suppose that while the low pressure crank was descending, which would be the case when it was pointing to the ship's side, the screws revolving outboard at the top, some obstruction got under it and stopped it suddenly. The momentum of the heavy screw would tend to cause the shaft to revolve round the crank pin. This it could not do without bursting up the keeps, and even then either the web must slip round on the crank pin or it must twist the pin. Now, in point of fact, the pin has not been twisted, but the crank web has slipped round on the pin, and the screw shaft center is no longer in line with the crank shaft center. It is abundantly clear that something occurred to stop the revolution of the shaft; but further evidence is supplied by a great score in the crank web, due, apparently, to collision with some obstacle.

"But it may be said all this is no doubt true, but the obstacle was something which fell into the crank pit after the engine broke down from racing. A little reflection will show that this proposition is, standing alone, untenable. The screw shaft must have had some powerful twisting force acting on it from the after end, and that could only have been supplied by the momentum of the propeller. Nothing forward of the after crank shaft bearing could have ripped up the screw shaft all along the alley. That resulted from the effort made by the shaft to revolve about a new center when the crank was suddenly stopped; but no rotative effort forward of the after crank shaft bearing could, as we have said, have brought about a lifting effort of the kind wanted. This seems to us to be almost conclusive evidence that the screw shaft did not break until after the engine gave way.

"We are now in a position to advance an explanation which, though not complete, goes some little way toward completeness. The screw shaft was no doubt injured by bending, as we explained last week. The breakdown was brought about by some obstruction which prevented the rotation of the crank shaft. The screw then ripped up the shaft out of its bearings, and the weakened tail end, being unable to bear the strain, broke. The sudden jerk on the guides was, of course, tremendous. The connecting rod was bent, and the steel frames were, by the side effort, snapped off short at the bed plate.

"The question remaining for solution is, What caused the obstruction to the rotation of the crank? This is a point which may or may not be cleared up in the future. We have no certain solution to offer, nothing, in fact, more than a guess, which must be taken for what it is worth. The low pressure piston was a steel casting, with a thin coned body and a heavy rim to take the packing. In such a casting it is almost impossible to eliminate severe initial stresses, set up during cooling. The cracking of large pistons is an exceedingly common occurrence, and we could cite more than one recent case where a thin conical piston has parted from the rod. If the piston broke, and a large portion of it fell to the bottom of the cylinder, the remaining portion coming down on this would cause just such a jar as was needed for the lifting of the screw shaft in the way we have described. The bursting of the cylinder would take place at the same instant.

Regulation of College Athletics.

The University of Pennsylvania authorities have at last taken a hand in college athletics, and hereafter the students will be more restricted in the various sports. A set of rules, drawn up by a committee consisting of several of the faculty and representative undergraduates, will in the future govern all college contests:

Among the rules is this: No student whose general average in the mid-term or term report is below "medium" shall be permitted to engage in any university athletic contests or match rowing races, or play in any match games of base ball, foot ball, cricket, tennis, lacrosse, etc.

The City of Paris.

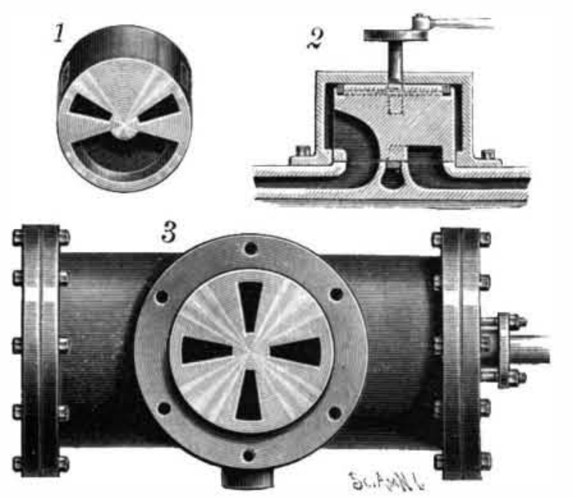
Iron concludes that, whatever may have been the immediate cause of the breakdown of the starboard engine of the City of Paris, considerable may be learned from the accident. In the first place, the transverse bulkheads have proved their ability to keep the vessel

Fig. 1.—ETCHED IRON CASKET IN THE BAVARIAN NATIONAL MUSEUM IN MUNICH—THE END.

afloat, although both engine rooms were filled with water. Secondly, the longitudinal bulkhead between the port and starboard engine rooms was not strong enough to prevent an accident to one from rendering the other engine useless. This bulkhead should be strengthened, so that each engine room should be practically bomb-proof against the other. Finally, there should have been valves in the circulating pipes between the engine room and the hull, which could be shut from the upper deck in case of the breakage of these pipes in the engine room. This would perhaps have prevented the filling of the engine rooms with water. It is a great satisfaction to know that the accident was not attended with loss of life, and that the vessel did not go to the bottom even after it reached Queenstown harbor.

AN IMPROVED VALVE.

The illustration shows an oscillating valve, patented by Mr. John C. Wood and Caleb F. Houston, designed to permit the easy reversing of the engine and obviate the wearing of a hollow seat when set to cut off at short stroke. Fig. 1 represents the valve in perspective, Fig. 2 being a sectional side elevation of the improvement as applied, and Fig. 3 showing the cylinder. The engine cylinder has the usual inlet and outlet ports opposite each other, over which operates the circular valve, turning in the steam chest, and in the valve, at angles to each other, are ports adapted to connect alternately with the live steam ports, and extending through the rim of the valve, as shown in Fig. 1, so as to lead into a circular steam space in the steam chest. In the under side of the valve is an exhaust cavity adapted to alternately connect the inlet ports with one of the exhaust ports, according to the direction in which the engine is running. The valve has a central spindle carrying a slotted link pivotally connected



WOOD & HOUSTON'S VALVE.

with a rod connected with the engine-driving shaft, to impart an oscillating motion to the valve, the pivot of the rod on the link being adjustable for governing the cut-off. The motion of the valve can be reversed by connecting the rod to the other end of the link. In the top of the valve is an annular groove in which fit a number of split rings forming a packing.

For further information relative to this invention address Mr. Caleb F. Houston, Albuquerque, New Mexico.

ETCHING.

ETCHING METALS.

There are two ways of etching metals, which produce different effects. According to one method, the design is cut, while the ground remains bright. According to the other method, the ground is etched, while the design remains bright.

Lines may be formed on any of the base metals by coating the surface thinly with beeswax, scratching the design through the wax by means of a needle or any sharp instrument, finally applying to the surface a solution formed of 1 part of nitric acid, 1 part of sulphuric acid, and 8 parts of water.

Usually a rim of wax is placed around the surface to be etched, to confine the acid. After the surface has been sufficiently etched, the acid solution is poured off, the surface is washed with water, and dried, when the wax is removed by a cloth after the metal has been heated sufficiently to soften or melt the wax.

To produce an etched ground with a bright figure, this method is reversed, *i. e.*, the design is drawn with asphaltum varnish, and the ground is exposed to the action of the acid.

In Fig. 1 is represented the end of an etched iron casket of the sixteenth century, which is an example of this kind of work. After the etching is complete the work is washed as in the other case, and the asphaltum is dissolved off by means of a cloth wet with turpentine, leaving the design bright.

GLASS ETCHING.

Glass may be etched as readily as iron or steel. The method is about the same, the only difference being in the kind of acid employed.

The glass to be etched is completely coated with

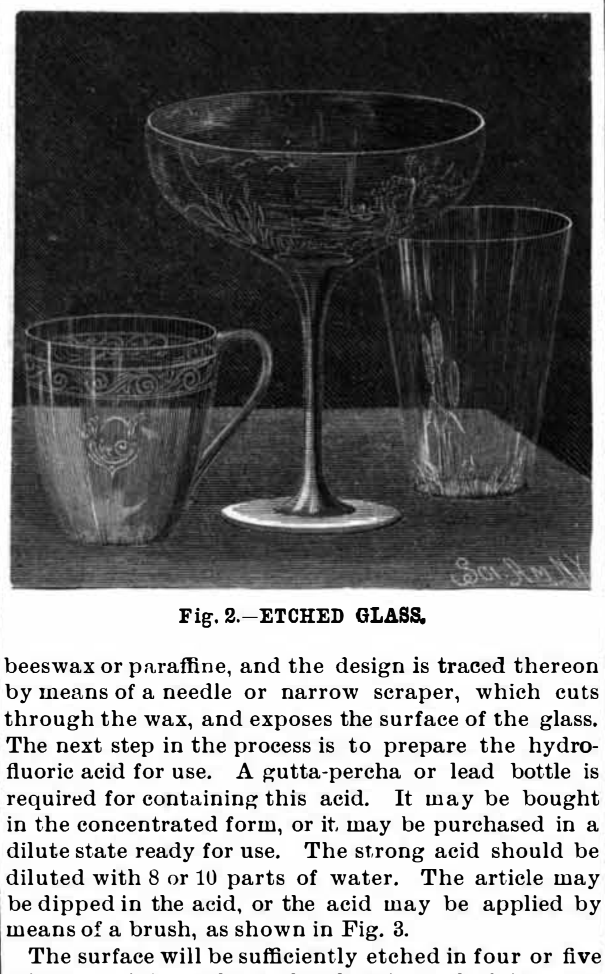


Fig. 2.—ETCHED GLASS.

beeswax or paraffine, and the design is traced thereon by means of a needle or narrow scraper, which cuts through the wax, and exposes the surface of the glass. The next step in the process is to prepare the hydrofluoric acid for use. A gutta-percha or lead bottle is required for containing this acid. It may be bought in the concentrated form, or it may be purchased in a dilute state ready for use. The strong acid should be diluted with 8 or 10 parts of water. The article may be dipped in the acid, or the acid may be applied by means of a brush, as shown in Fig. 3.

The surface will be sufficiently etched in four or five minutes. After etching, the glass is washed in water and dried, when the wax coating is melted, and removed by means of a cloth. The design will appear as a dull or frosty surface.

The operator should be very careful to avoid inhaling the fumes of the acid, and also to avoid touching the skin with it, as it produces painful ulcers, which are long in healing.

It is obvious that beautiful designs may be made in this manner upon window screens, lamp shades, mirror borders, etc.

Laying Pipes under Water.

Mr. F. S. Pecke, a civil engineer at Watertown, N. Y., lately accomplished in a very simple, cheap, and expeditious way what is usually a difficult and expensive operation—the laying of a long line of pipe in deep water. He had occasion to lay nearly 1,000 feet of suction pipe at Rouse's Point. The water was needed for manufacturing purposes, and as it was found that water near the shore was more or less roily and impure, it was necessary to place the inlet a considerable distance out in the lake. He purchased for the purpose a steel pressure pipe of 8 in. diameter, manufactured by the Spiral Weld Tube Co., at East Orange, N. J., and used for couplings cast iron flanges, weighing, with bolts and gaskets, about 65 lb. to the pair. Plugging the end of the first length, he pushed it out on the surface of Lake Champlain, and connected the second length, pushing this out in turn, until the whole line was coupled. It then presented the unusual spectacle of a line of 8 in. pressure pipe nearly 1,000 ft. long, floating with a displacement of only 3½ in. of its

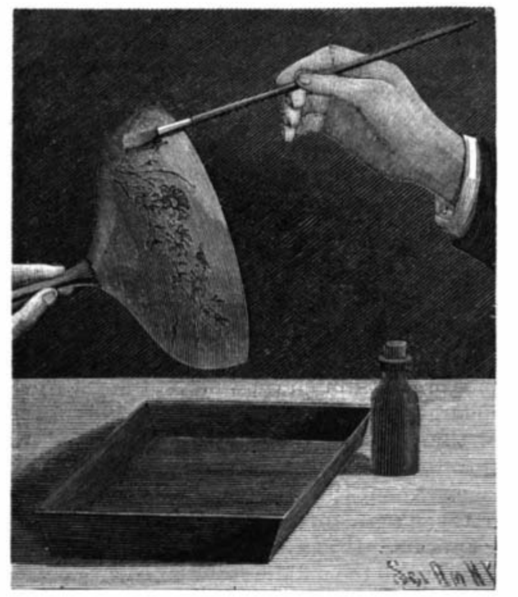


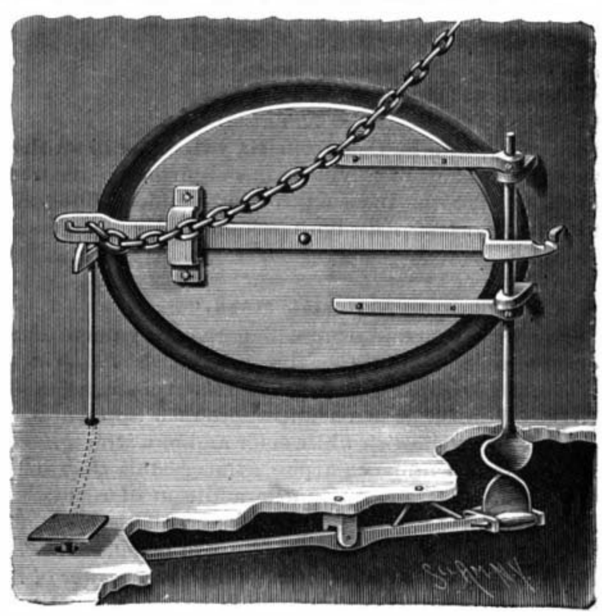
Fig. 3.—ETCHING GLASS.

diameter. When the requisite length had been connected the line was towed to position, the plug at the end removed, and the pipe sank easily in 16½ ft. of water without breaking a joint or receiving any injury. No buoys or floats were used in the operation, and no apparatus of any kind. The pipe is now in use as the suction of a steam pump, and gives perfect satisfaction. Work of this kind usually involves the use of expensive and troublesome flexible joints, and Mr. Pecke's neat and ingenious expedient is worthy of record and of imitation under like conditions.

It is obvious, says *Engineering News*, that this could hardly have been done with cast iron pipe, on account of its rigidity and liability to fracture.

AN IMPROVED FURNACE DOOR OPENER.

A device designed to facilitate the opening and closing of furnace doors, and especially adapted for application to the doors of locomotive furnaces without any alteration in the present ordinary forms of construction, is shown in the accompanying illustration, and has been patented by Mr. George F. Moors, of Owensborough, Ky. Beneath the floor in front of the furnace is pivoted a lever, one end of which terminates in a treadle extending above the floor, while the other end has horizontal aligning rollers adapted to engage the twisted lower end of a vertical shaft with which the rear end of the furnace door is rigidly connected, whereby pressure on the treadle end of the lever, moving the rollers up on the spiral of the shaft, will swing open the furnace door. When the pressure on the treadle is removed, a spring returns the lever to its normal position and thus closes the door. Another lever is also so pivoted that the pressing down of the



MOORS' FURNACE DOOR OPENER.

treadle gives vertical movement to a rod on the upper end of which is a shoulder normally resting in the bottom of the latch catch, whereby the latch bar is released simultaneously with the movement of the lever for opening the door. The latch bar extends all the way across the furnace door and has on its rear end a catch adapted to engage a similar catch projecting from the wall of the furnace at the rear end of the door, whereby the door may be held open when desired after the pressure has been removed from the treadle.