tached to A. At the lower end the boiler A, is provided with a double bottom *d*, while the upper end is surrounded by a spiral tube *c*, its spiral being in reverse of those of the interior worm or screw *s*. The double bottom of the boiler forms a water space K, which communicates through circular holes *a*, with the inner space of the shell A. The machine is mounted on a sloping axle-tree, which is stepped at *t*, and supported above on the shaft *l*, and bar *b*. The motion of shaft *l*, is transmitted to the horizontal shaft *h*, by means of the flexible connection. The lower part of the shell A, is surrounded by a furnace of clay B, and fire is applied through an opening at *f*. In this example a gas flame is employed. The products of combustion rise from *f*, and surround the shell A, finally escaping through the upright pipe, at the upper end of B. The boiler A, is filled with water at *i*, and here a fusible plug is used, which melts when the temperature of the steam rises above that of a given pressure, and permits the escape of steam into the atmosphere, thus ensuring the safety of the apparatus. When the fire is kindled at *f*, the steam which developes rises through the water and acts on the spirals *s*, causing the turning of the whole machine. The steam continues to rise until it reaches and enters the spiral condensing pipe *c*, which surrounds the upper exterior portion of the shell A. In passing through the pipe *c*, the steam is condensed, and the water of condensation is screwed back by the rotation of the pipe *c*, down below the water level in the boiler A, near *o*, where the water enters the boiler, and is again converted into steam. In starting the machine the steam must first be allowed to escape at *o*, out of the spiral condenser, in order to drive out all the air; then the opening *o*, is closed, and the steam, then rising into the cooling pipes *c*, is condensed as before described.

The machine, if once filled and made completely tight, continues to work without requiring any other attention, except to keep the fire going. No pumps to supply water, or valves or other devices are required, but a constant use of the same water over and over again takes place; the water being first converted into vapor, which is then condensed, then again evaporated, and so on.

In lieu of water other liquids may be employed, and it has been suggested that quicksilver might be advantageously used.

## PHOSPHOR-BRONZE.

This new alloy, which has been recently brought before the public for obvious reasons, is likely to be much patronised, especially in manufactures where steel is useless or dangerous. The reasons given by the patentee are that it can be made, according to the wish of the operator, more ductile than copper, as tough as wrought-iron, or as hard as steel; it possesses great fluidity; its homogeneity is complete, and its grain is as fine as that of cast steel. It may be perfectly controlled to suit any particular purpose for which it is intended it can be made either hard or soft, tough or brittle, and its ductility, elasticity, or hardness can be regulated with the most perfect accuracy. Unlike other alloys, it can be remelted without any material loss or alteration of its quality, while heavy steel castings, when worn out or broken, are comparatively worthless.

A great variety of objects hitherto worked in iron and steel may now be cast in the new alloy, and in many cases they require only a polish to make them ready for use; beside which they do not corrode, as articles of iron or steel do. The great fluidity, compactness, and fine grain, as also the beautiful colour of the metal, especially recommend it for decorative art, and the perfection of the castings greatly reduces the cost of chasing and finishing. This alloy stretches more than copper or any of its ordinary compounds, and plates have been reduced, by a single cold rolling, to one-fifth of their thickness, the edges remaining perfectly sound and without crack. But perhaps the greatest advantage of phosphor-bronze is its incapacity to emit sparks. Tools, knives, scissors, and other articles, such as locks, keys, &c., have therefore already been largely made from it by gunpowder manufacturers. Bearings, pit-ropes, telegraph-wire, tuyères, cannon, cartridge-cases, pistols, bells, &c., have also been made of this metal.

By order of the Prussian Ministry of Commerce, experiments have been made with the various kinds of phosphor alloy, the object of which was to ascertain the resistance of the metal to repeatedly applied strains or pulls, and also to bends of a given force. The first bar fixed on the stretching machine resisted 408,230 pulls of 10 tons per square inch, while a bar of ordinary bronze broke before even the strain of 10 tons per square inch had been attained. Another bar withstood 147,850 pulls of 12½ tons per square inch. Still more favourable results have been obtained on a machine by which the test bar was bent as often as 40,000 times per day. In this instance it resisted 862,980 bends of 10 tons per square inch, while the best gun-metal broke after 102,650 bends of the same force. Another bar which was being tested withstood 1,260,000 bends of 9 tons' force per square inch, without showing any signs of weakness.

The foregoing remarks show the great adaptability of phosphor-bronze for all articles hitherto manufactured of ordinary bronze or gun-metal, and although the primary cost may exceed that of other alloys, the ultimate result will be in its favour, owing to its extra durability, lightness, and capability of reconversion. In fact it may be said that what steel is to cast-iron, phosphor-bronze is to ordinary bronze. The patentees have received diplomas and medals of merit and progress from the Vienna Exhibition.

## WATER AS FUEL.

A patent for "An improved method or process and apparatus for securing the combustion of fuel and the utilisation of the gases arising therefrom" has been obtained by Mr J. Ramsden, of Lightcliffe. His apparatus is now in operation, and is thus described by the *Halifax Guardian*:—Mr. Ramsden burns steam, and the means used to effect its combustion are very simple. As the appliances are so far merely for experimental purposes, they are of a miniature description. On a bed, about 5 ft. square, stands a small double-cylinder steam-engine of ordinary construction. The boiler which supplies the motive-power is a mere toy, being about 2 ft 6 in. long, and 15 in. or 16 in. diameter, of the single-flued Cornish pattern, the flue being about 6 in. diameter. Instead of the ordinary furnace-fire bars for burning coal, there is a coil of small iron-piping which takes three turns round the inside of the furnace or flue. In this pipe are drilled eighteen small holes of about one-sixteenth of an inch diameter. These holes are so arranged that when steam is admitted to the coil it rushes out through them, forming a circle of jets which meet in the centre of the furnace. Across the front of the fire-hole or furnace runs another small pipe with two more jets directed into the flue. Immediately in front of these two latter jets are two brass nozzles, the orifices of which are scarcely discernible, connected with a vessel containing petroleum. There are cocks to regulate the supply of petroleum and steam. As the boiler must necessarily be cold to begin with, and as steam is the fuel to be burned, recourse is had to a small auxiliary boiler in which a little steam is generated by ordinary means. This generator is temporarily connected with the coil inside the furnace, a tap is turned, and the steam rushes out of the jets. At the same time another tap is turned, and the petroleum issues from the nozzles. A light is then applied to the petroleum, and instantly the steam is decomposed and ignited, and the furnace is a roaring blast of flame. In a few minutes steam is up in the boiler, and becomes independent of the generator first used. The result is startling and wonderful. The effect of the rush of steam from the jets is to draw the petroleum through the nozzles, and petroleum or any other hydro-carbon having the power to decompose steam, the interior of the flue becomes a furnace of great heat. So intense is this heat that, although steam rushes through the coil, it becomes almost white hot in a very few minutes. A not less important feature of this invention is its adaptability to illuminating purposes. The large quantity of inflammable gas generated would, if not intercepted, escape unconsumed. To utilise this waste Mr. Ramsden brings the steam-engine into operation, geared to a small rotary fan, sending it into a closed vessel containing petroleum. From this receptacle it is conducted to a gasometer, and used exactly in the same manner as ordinary gas. This gas has no smell, and literally no smoke. Its cost, adds our authority, is ridiculously small. Mr. Ramsden contends, and with a show of reason, that it cannot cost more than 9d. a thousand.