officers' quarters. The deck erections are of teak ; the forward deck house, which will be used in warm climates as a dining room, is done up in mahogany. From here a staircase leads down to the dining saloon, which is an elaborate apartment, the sides of which are of ebony. Throughout the cabins there is a complete installation of electric bells and hot water heating arrangements. Forward of the saloon on the port side is Mrs. Brooks' room, which is finished in rosewood. Opposite Mrs. Brooks' room is the owner's room, adjoining which is a light bathroom and lavatory, the floor of which is mosaic. Aft of dining saloon, on the port side, is the pantry, with a lift to the galley, which is aft of the forward deck house. Near the pantry there is plenty of storage accommodation. Aft of the engine and boiler casing there is the after deck house, which will be used as the smoking room. It is a nice light compartment done up in rosewood. Going down the staircase from the smoking room we come to two handsomely got up staterooms on the port and starboard side. These are excellently furnished, the paneling being of sycamore wood. Abaft of these rooms are a large stateroom and the ladies' cabin, both finished off in white enamel. The "Andria" carries quite a complement of boats on her davits, including a Dartmouth built ten and one-half knot steam launch.

The "Andria" was one of the yachts which took part in the Jubilee Naval Review at Spithead on June 24.

ROMAN BATHS.

In the earliest times we have records of people bathing in the rivers Nile and Ganges. From an early period the Jews bathed in running water, using both hot and cold baths and employing ointments. Baths were also largely used among the Greeks, and they are credited with the invention of the hot air bath. The baths of the Greeks and probably of all the other European nations were on an insignificant scale as compared with those that eventually sprung up among the Romans.

The sturdy Romans of republican times used to throw themselves in the Tiber after exercising, but after ample supplies of water had been brought into the city, cold swimming baths were constructed. Next public baths as well as private baths were built, and with the empire more luxurious forms of bathing were introduced, and warm bathing became more popular than cold bathing. In the third century A. D. there were in Rome 11 large public baths and 926 private baths. Prof. Lanciani has computed that the baths of Caracalla could accommodate at one time 1,600 people and the baths of Diocletian 3,600, so that taking 1,500 as an average accommodation of each public bath and 50 as that of the private baths, he estimates that over 62,800 people could have bathing accommodations at one time. In addition to this there was the Tiber and the streams in the Campagna. Many of the baths were magnificent, the appointments being most luxurious. They were in a way gigantic clubs, stately and splendid pleasure houses, and from early in the morning, when they were opened, a constant stream of people passed in until they were closed at sunset. Though the baths were called "public," a small charge was made for admission. It was often only about one cent, but as cheap as this was, emperors used frequently to ingratiate themselves at times with the populace by making the baths gratuitous.

Visitors very often stayed an entire day in the beautiful buildings, enjoying the society of their friends. When the visitor entered the building, his outer wraps were given to a wardrobe keeper. He then met his friends and obtained the news of the day, after which he selected the variety of bath which he preferred, as warm, tepid, shower, cold or perspiration bath. After taking the bath he walked up and down the beautiful grounds, which were a feature of all the great baths. He then indulged in gymnastics or athletic sports to give him an appetite for the meal which followed. The dinner finished, the visitor could indulge in any of the many amusements which the enormous club house afforded, as concerts, literary entertainments, etc.,

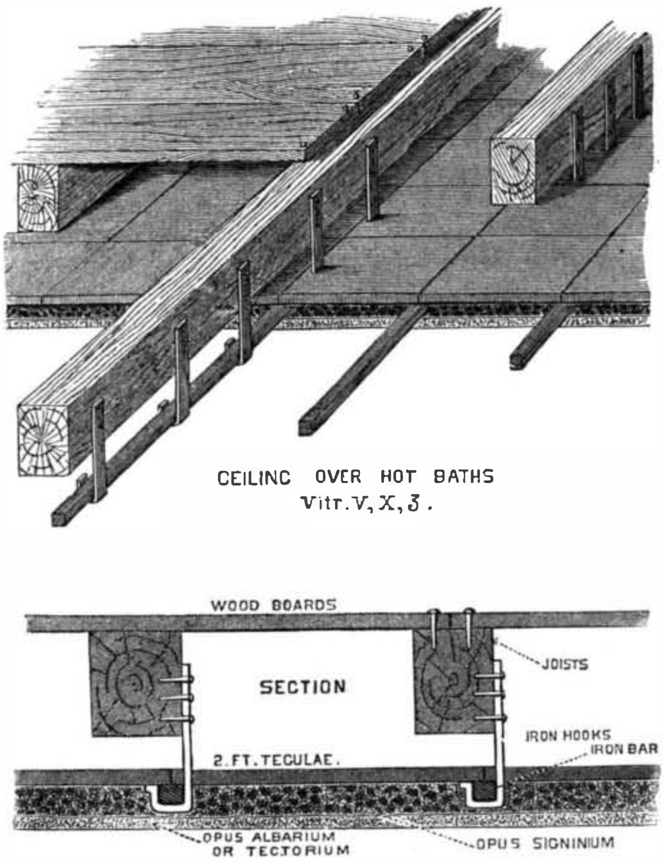


Fig. 1.—THE CONSTRUCTION OF A ROMAN BATH.

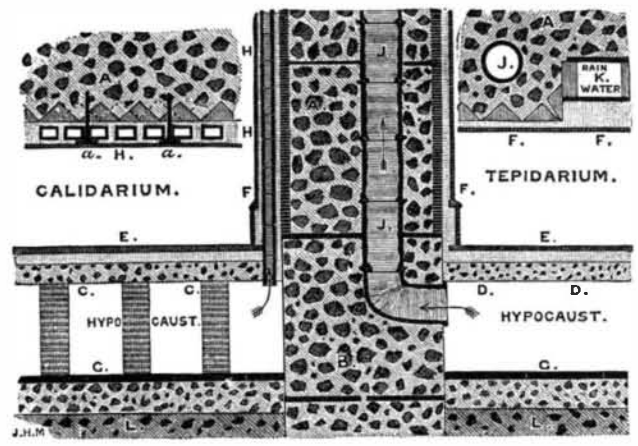


Fig. 2.—SECTION THROUGH THE FLOORS AND WALLS OF THE BATHS OF CARACALLA.

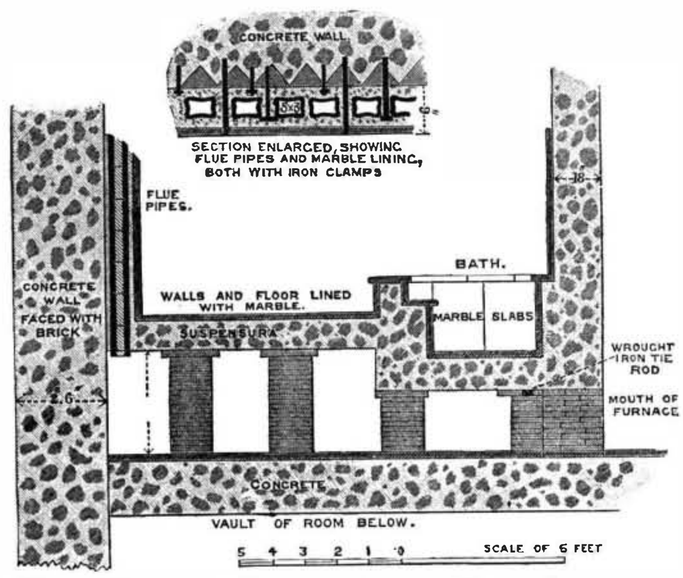
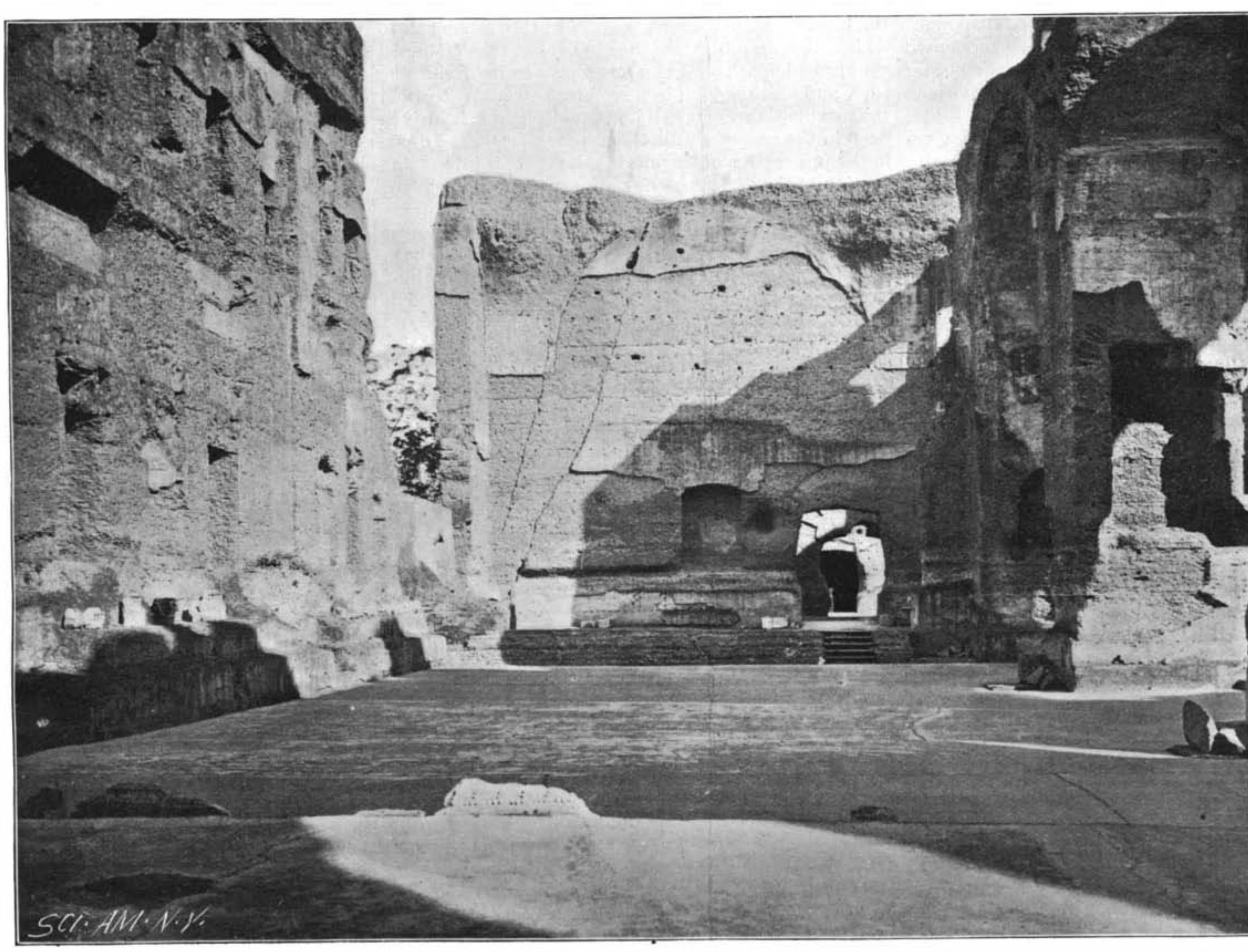


Fig. 3.—SECTION OF A PRIVATE BATHROOM IN THE ATRIUM VESTAE.



THE FRIGIDARIUM, OR SWIMMING BATH OF THE BATHS OF CARACALLA, ROME.

which were provided for those who wished to enjoy them. Sometimes a second bath was taken to prepare for the evening meal. It will readily be seen that as three or four thousand people visited the great baths every day, a very large number of servants and slaves were necessary to care for them.

The arrangements which were adopted to run the establishment are so interesting that we reproduce several engravings from the work of the late J. Henry Middleton, "The Remains of Ancient Rome." These illustrations show the methods of heating and fireproofing the baths. We also give an illustration of the present condition of the "*frigidarium*" or swimming bath of the Baths of Caracalla. The portion of the baths which we shall consider is entirely separate from the constructions which were devoted especially to the entertainment of the bathers. The chief rooms in the largest establishments appear to have been put to distinct uses, but in the smaller baths, one chamber was made to do duty for more than one purpose. The chief departments in the large baths were:

1. The *apodyterium* or *spoliatorium*, where the bathers undressed.

2. The *alipterium* or *unctuarium*, where the oils and ointments were kept (although the bathers often brought their own pomades), and where the "*aliptae*" anointed the bathers.

3. The *frigidarium*, or cool room (*cella frigida*), in which usually was the cold bath, the *piscina* or *baptisterium*.

4. The *tepidarium*, a room moderately heated, in which the bathers rested for a time, but which was not meant for bathing.

5. The *calidarium*, or heating room, over the *hypocaustum* or furnace; this in its commonest arrangement had at one end a warm bath, the *alveus* or *calida lavatio*; at the other end in a sort of alcove was:

6. The *sudatorium* or *laconicum*, which usually had a labrum or large vessel containing water, with which bathers sprinkled themselves to help in rubbing off the perspiration.

The rooms which were devoted to bathing proper were often of enormous size. The walls were usually constructed of brick or concrete and the roof was also of concrete. It was necessary to have the walls and ceilings fireproof, as a certain amount of wood was used in the construction.

We present an engraving giving a perspective sketch and section to illustrate the Vitruvian system for protecting the wooden ceiling joists over the hot rooms of the baths by an inner ceiling of tiles. The air space helped to keep the room at an even temperature. The whole under surface of the woodwork had a series of iron bars at intervals of two feet. These bars were supported by iron hooks nailed to the ceiling joists. Tiles two feet square were laid on the rows of iron bars, thus covering the whole areaof the ceiling. The under side of the tiles was covered with a very hard cement called the "*opus signinum*." Entirely over this was laid an ornamental coating of fine white stucco made of pounded white marble, the so-called "opus albarium." This was so constructed as to prevent the condensed steam from the hot baths striking through the plaster ceiling and the tiles, and causing the wooden joists to rot.

The floors of the baths were carried upon what are called crypto-porticoes, which allowed the servants to appear suddenly in all places, enabling them to attend to the requirements of the bathers without crossing the halls or interfering in any way with the noble Romans. The description by Vitruvius of the hypocausts or hollow floors used for heating the calidaria or hot rooms agrees closely with the existing ruins. We present an engraving, Fig. 2, from Prof. Middleton's work showing sections of the floors and walls of the baths of Caracalla, illustrating the different methods of heating. The *tepidarium* being heated by the hypocaust only, and the *calidarium* both by the hypocaust and the flue tiles up the walls. The following reference to the engraving shows the method of the construction in detail:

AA, concrete wall faced with brick; B, lower part of wall with no brick facing; CC, *suspensura* or upper floor of hypocaust supported by pillars; DD, another floor with support only at the edges; EE, marble flooring; FF, marble plinth and wall lining; GG, underfloor of hypocaust paved with large tiles; HH, horizontal and vertical sections of the flue tiles which line the walls of the *calidarium*; *aa*, iron holdfasts; JJ, socket jointed flue pipe of *tepidarium*; K, rectangular rain water pipe, used where there was a copious downflow of water; LL, vaults of crypt, or basement, made of pumice stone concrete.

The lower floors were laid with 2 foot tiles over a bed of concrete; and on this all over the room rows of pillars were built to support the upper or hanging floor (*suspensura*). These pillars were 2 feet high and were constructed of tiles 8 inches square, set not in mortar but with clay in the joints. In the existing examples these clay joints have been baked into brick by the action of the fire which played among the short pillars all over the space below what is called the *suspensura* (C C). The example of the hypocaust on the left side of Fig. 2 agrees exactly with the description of Vitruvius. Thaton the right is a later variety. It was from these hollow or hanging floors that Roman baths were sometimes called "*balnea pensilia*" or "*balneæ pensiles*." In later times the architects became bolder in their use of cements and concrete, so that the tiled pillars were frequently omitted and the whole upper floor was supported only at the edges as if it were one immense slab of stone. The *suspensura* or floor was about 18 inches in thickness and was formed of four distinct layers. This main mass was of rough concrete, then came a layer of pounded brick and potsherds. Over this was laid a thin bed of hard white marble cement, and upon it was embedded the marble tesserae or slabs, which formed the upper surface of the floor. The furnace was at one side or below the hypocausts, and the heated air or smoke from it, after circulating between the two floors, escaped up the flue which was formed in the thickness of the concrete walls. This flue was usually formed of a jointed pipe about 10 to 12 inches in diameter. The fluid concrete was poured around these flues. It is probable that the flues were continued above the roof, terminating in a chimney pot for the exit of the smoke, so that there was little risk of any rain water leaking in around the chimney pot.

Another method of heating is given by Prof. Middleton, and is shown at H H, Fig. 2. This was done by lining the hollow wall surface of the bath room with upright lines of flue pipes rectangular in section. These flues communicated at the bottom with the space under the *suspensura* and they were carried up to the top of the building, where the hot air and smoke escaped. Thus the whole wall surface, as well as the hollow floor, was strongly heated. It is believed that the exits of a large row of flue tiles were converged at one point before issuing to the roof.

The methods of heating which have been described were used not only under and around the hot air baths in the great "Thermae," but in the baths of private houses, as the "*atrium vestae*," or house of the vestal virgins.

Fig. 3 gives a section of the small bath room in the upper floor of the *atrium vestae*, showing methods of heating with the hypocaust furnace and the lining of the flue tiles up the walls. The hollow hypocaust passes under the floor of the room and also under the hot water bath, which is made of concrete faced with thin slabs of white marble. The mouth of the furnace is immediately under this bath, which is 6 feet long, 3¼ feet wide and 2 feet 4 inches deep. The pillars made of tiles, which support the *suspensura*, rest on the barrel vault of the room below. The space between the arches was filled in level with concrete and then paved with tiles, and upon these tiles the pillars rest. Three of the four walls of each of these rooms are covered with a hot air jacket in the form of a rectangular flue tile, which are bedded and covered with a thick mass of cement, against which the marble slabs rest, lining the whole surface of the walls.

This is shown in the horizontal section in Fig. 3. It also shows the nails which are driven into the joints of the brick work to form a "key" for the cement into which the flue tiles are bedded, also the **T** shaped clamps which are used at a few places to hold the flue tiles, and also the long iron or bronze clamps to hold the marble slabs. One end of these clamps is driven deep in the concrete wall, the other end is turned down in the upper edge of the marble slab. This interesting portion of the *atrium vestae* appears to date from the time of Severus, about 200 A. D., when important alterations and repairs were carried out. As the house decreases in importance, of course, the size of the bath rooms also decreases, but the general principle which governs the structure is the same, and therefore it affords an interesting study for the architect and archæologist. It is a curious fact that many of our modern systems of fireproofing structures depend largely upon the methods which the Roman architects used in constructing their baths.

The ruins of the Baths of Caracalla seem very confusing, but as soon as the orientation is understood, the plan of the enormous construction begins to unfold itself to the visitor, and he begins to understand how it was that the Romans were able to build masses of buildings easily and economically. When we consider the vaulting, which will probably always remain the crux of the architect who attempts to build in the Roman style, we must remember that it is not arched construction, but is monolithic. With his semiliquid cement the Roman architect was enabled to really cast his vaults. "Grandeur was the dominant trait of antique Rome," and even the coarse splendor of the empire could not efface the racial feeling for mass.

DR. KANDT, a German explorer, has started out to find the ultimate sources of the Nile. Having the promise of assistance from the Congo authorities when he reaches their territory, he has set out from German East Africa, intending to make his way to Urundu, Uhha, and Ruanda. There he will ascertain the size of Lake Akenjaru and measure the volume of water in the rivers Kagera, Ruvuru, Nyakirongo, and Akenjaru in the dry and wet seasons. He will trace that having the greatest volume to its source.

INTERESTING RECENT INVENTIONS.

We give herewith a group of recent inventions for which patents have been issued by the United States Patent Office within the last few weeks. They show the versatility of inventors, and seem to indicate that subjects for invention are not wanting. These examples are taken because of their novelty and originality.

ALMOND'S ROTARY ENGINE.—We have shown an improvement in that class of rotary engines in which tangential cylinders provided with outwardly movable pistons are contained within concentric casings. This invention has some features of interest which we do not remember to have seen in previous forms of rotary engines.

The housing, A, is stationary. The shaft, B, is arranged eccentrically in the housing and carries the head of the engine, consisting of four tangentially arranged cylinders, C, D, E, and F, provided with pistons, C^2, D^2, E^2, F^2. The outer end of each cylinder is open so as to allow the piston to protrude. The inner end of each cylinder has a port, j, for the admission and exhaust of steam. Steam is admitted by a pipe, G, to an inlet pipe, k, formed in the head, d, of the housing, and it is exhausted through the pipe, H, from an outlet port, l, which is also formed in the head, d. The inlet port, k, is of such length as to allow the cylinder, F, as soon as it moves from the position shown, to receive steam, which it continues to receive until it reaches the position of the cylinder, D. The outlet port, l, is of such size and length as to allow a cylinder to exhaust when it reaches a position a little in advance of the position of the cylinder, D, as here shown, and it continues to exhaust until it reaches the position occupied by the cylinder, F.

Each of the pistons carries on a tubular central stem a pivoted shoe, having a steam passage in its pivotal portion communicating with a steam space formed in the shoe, and between the shoe and the cylindrical wall of the housing, A. When steam is admitted to a cylinder, it passes through the tubular stem into the steam space in the shoe, forming a cushion which opposes the outward pressure of the piston, thus avoiding friction, the steam space in the shoe having approximately the same area as the piston itself.

Rotary motion in this engine is the resultant of the outward pressure of the pistons and their angular advance.

This interesting machine is the invention of Mr. Thomas R. Almond, of Dunwoodie Heights, New York.

TURNER'S FIELD MAGNET.—This improvement in field magnets of dynamo electric machines and electric motors was invented by Mr. Charles P. Turner, of this city.

The magnetic permeability of iron used in the field magnet cores of dynamos and motors is much affected by the presence in the iron of carbon, phosphorus and other impurities, which decrease the power of the field magnets for creating lines of force. Alloying iron with other metals also causes losses which are considerable.

This invention is designed to partly or wholly prevent these losses and thus increase the efficiency of the dynamo or motor. The invention is extremely simple. It consists in the combination with the polar extremities of the cast or wrought iron field magnet of a facing of pure iron on the surface adjacent to the armature. The pure iron is deposited electrolytically, and being homogeneous throughout, insures greater permeability than can be realized in the best forgings or castings.

LIVINGSTON'S SOUNDING BOARD.—The engraving only half conveys the idea of the important invention it is designed to illustrate. This is a new sounding board for pianos and other musical instruments, which is designed to give the instrument a greatly improved quality of tone in both the treble and bass, the resonant qualities of the sounding board being proportioned to the requirements by using soft grained wood in the board in the regions vibrated by the lower strings, and fine hard grained wood in the portions vibrated by the higher strings.

In the construction of this sounding board the inventor not only improves the quality of the board, but he is enabled to use short pieces of hard grained lumber which have heretofore been wasted.

The inventor, Mr. James C. Livingston, of Little Falls, N. Y., has succeeded in securing broad claims for his simple but important invention.

LOTHERINGTON'S SAIL ATTACHMENT FOR BICYCLES.—The illustration shows an attachment to bicycles, which will be appreciated by wheelmen, who, after having ridden against head winds, are able to set sail and go without exertion in the opposite direction.

The invention is a simple and compact attachment by means of which sails, carried by spring rollers, are spread and held in the position of use by gaffs hinged by a ball and socket joint to the upper end of the roller casings. The gaffs, when the sails are furled, lie over the sails in the casings or tubes, closing them. The rider may readily set the sails by pulling chains or cords attached to the gaffs.

The inventor of this device is Mr. Thomas Lotherington, of Ardmore, Indian Territory.

BERG'S FEED WATER REGULATOR.—This is a differential feed water regulator, used for regulating the