"The Helicoidal or Wire Stone Saw"

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Peggy B. Perazzo
Email: pbperazzo@comcast.net
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"The sides of solid bodies, whatever be the degree of hardness, and however fine the texture, possess surfaces formed of a succession of projections and depressions. When two bodies are in contact, these projections and indentations fit into one another, and the adherence that results is proportional to the degree of roughness of the surfaces. If, by a more or less energetic mechanical action, we move one of the bodies with respect to the other, we shall produce, according as the action overcomes cohesion, more or less disintegration of the bodies. The resulting wear in each of them will evidently be inversely proportional to its hardness and the nature of its surface; and it will vary, besides, with the pressure exerted between the surfaces and the velocity of the mechanical action. We may say, then, that the wear resulting from rubbing two bodies against each other is a function of their degree of hardness, of the extent and state of their surface, of the pressure, of the velocity, and of the time.

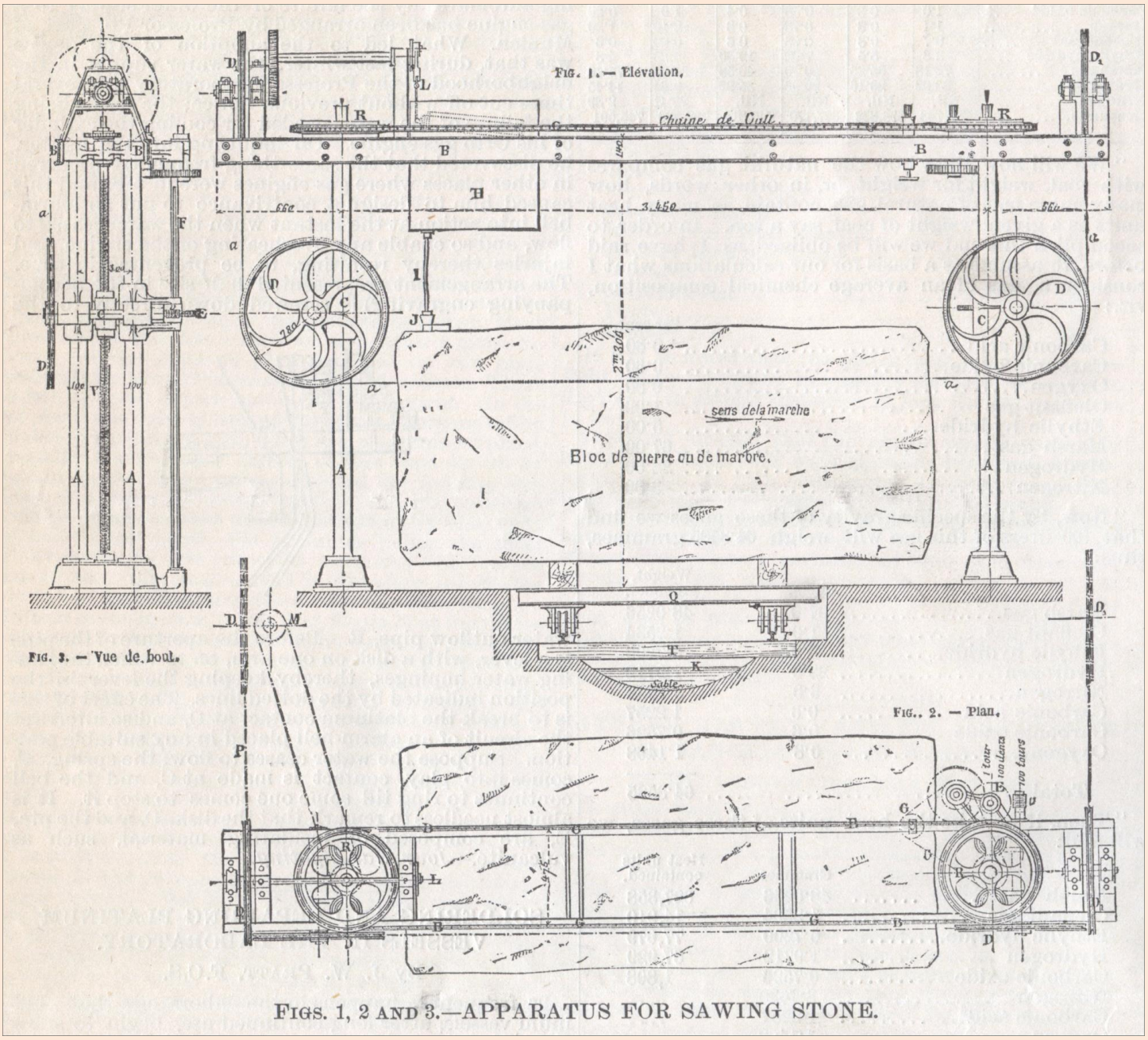
"According as these factors are varied in a sense favorable or unfavorable to their proper action, we obtain variations in the final erosion. Thus, in rubbing together two bodies of different hardness and nature of surface, we obtain a wear inversely proportional to the hardness and state of polish of their surfaces. Through the interposition of a pulverized hard body we can still further accelerate such wear, as a consequence of the rapid renewal of the disintegrating element.

"The gradual wear effected over the entire surface of a body brings about a polish, while that effected along a line or at some one point determines a cleavage or an aperture.

"The process usually employed in quarries or stoneyards for sawing consists in slowly moving a stone-saw backward and forward, either by hand or machinery, and with scarcely any pressure. Mr. P. Gay, however, devised a new process, which is based upon the theoretical considerations given above. His *helicoidal saw* is, in reality, an endless cable formed by twisting together three steel wires in such a way as to give the spirals quite an elongated pitch.

"The apparatus in its form for cutting blocks of stone into large slabs (Figs. 1, 2, and 3) consists of two frames, A A, five feet apart, each formed of two iron columns, 7 ½ feet in height and one foot apart, fixed to cast iron bases resting upon masonry. At the upper part, a frame, B B, formed of double T-irons cross-braced here and there, supports a transmission composed of gearwheels, R R, and a pitch-chain G G. Along the columns of the frame, which serve as guides, move two kinds of pulley-carriers, C C. The pulleys, D D, are channeled, and receive the cable, *a a*, which serves as a helicoidal saw. The direction of the saw's motion is indicated by the arrow. The carriages, C C, are traversed by screws, V V, which are fixed between the columns. The extremity, *v*, of the axle of the pulley to the right is threaded, and actuates a helicoidal wheel, E, which transmits motion to the wheel, R, through the intermedium of the vertical shaft, F. This transmission, completed by the wheels, R R, and the pitch-chains, G G, is designed to move the saw vertically, through the simultaneous shifting of the carriages, C C. A tension weight, P, through the intermedium of pulleys, D_1. D_1. permits of keeping the saw taut. A reservoir, H, at

the upper part of the frame, B B, contains the water and sand necessary for sawing. The feeding is effected by means of a rubber tube, I, terminating in a flattened rose, J, which is situated over the aperture made by the saw. A small pump, L, over the reservoir takes water from K, and raises it to H. The sand is put in by hand.



FIGS. 1, 2 AND 3.—APPARATUS FOR SAWING STONE.

"Above the basin, K, a system of rails and ties supports the carriage, Q, upon which is placed the block of stone to be sawn. When one operation has been finished, and it is desired to begin another, it is necessary to raise the pulley-carriers and the saw. In order to do this quickly, there is provided a special transmission, M, which is actuated by hand, through a winch.

"The work done by this saw is effected more rapidly than by the ordinary processes, and certain very hard rocks, usually regarded as almost intractable, can be sawed at the rate of from one to one and a half inches per hour.

"For sawing marble into slabs of all thicknesses, the arrangement described above may be replaced by a system consisting of two drums having several channels to receive as many saws, or two corresponding series of channeled pulleys, *b b* (Fig. 4), independent of each other, but keyed to the same axles, *i i*. When the pulleys have been properly spaced by means of keys, the whole affair is rendered solid by a bolt, *g*. The extremity of the axles forms a nut into which pass vertical screws, *c c*. These latter are connected above with cone-wheels, *l l*, which, gearing with bevel wheels keyed to the shafts, *e*, secure a complete interdependence of the whole. The ascending motion, which is controlled by the endless screws, *f*, and the helicoidal wheels, *m*, is in this way effected with great regularity. Uprights, *a a*, of double T-iron, fixed to joists, *k k*, and connected and braced by pieces, *d d*, form a strong frame.

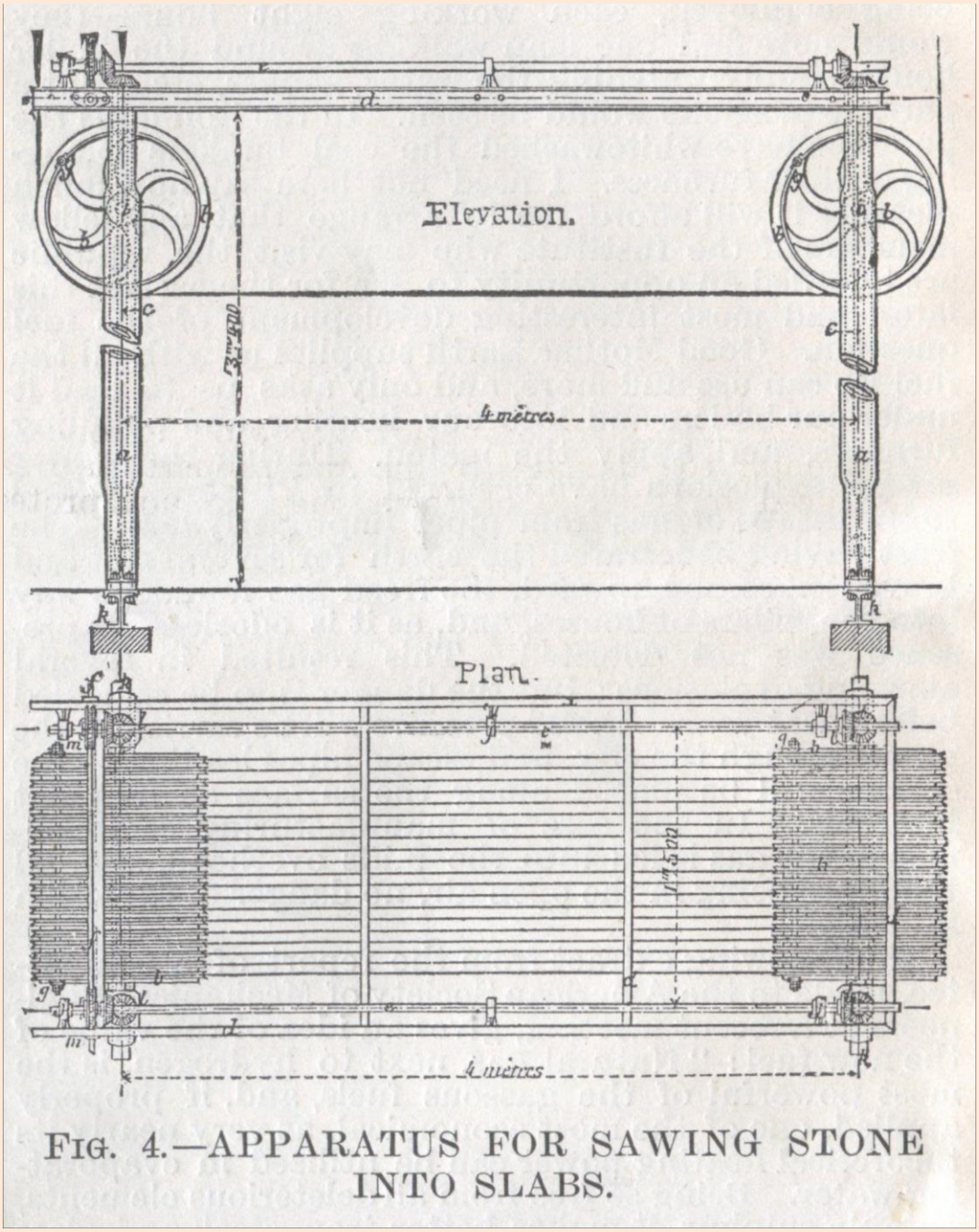


FIG. 4.—APPARATUS FOR SAWING STONE INTO SLABS.

"The power necessary to run this kind of saw is less than *n* x ¼ H.P., on account of the number of passive parts. The most interesting application of the helicoidal saw is in the exploitation of quarries. Fig. 5 represents a Belgian marble quarry which is being worked by Mr. Gay's method.

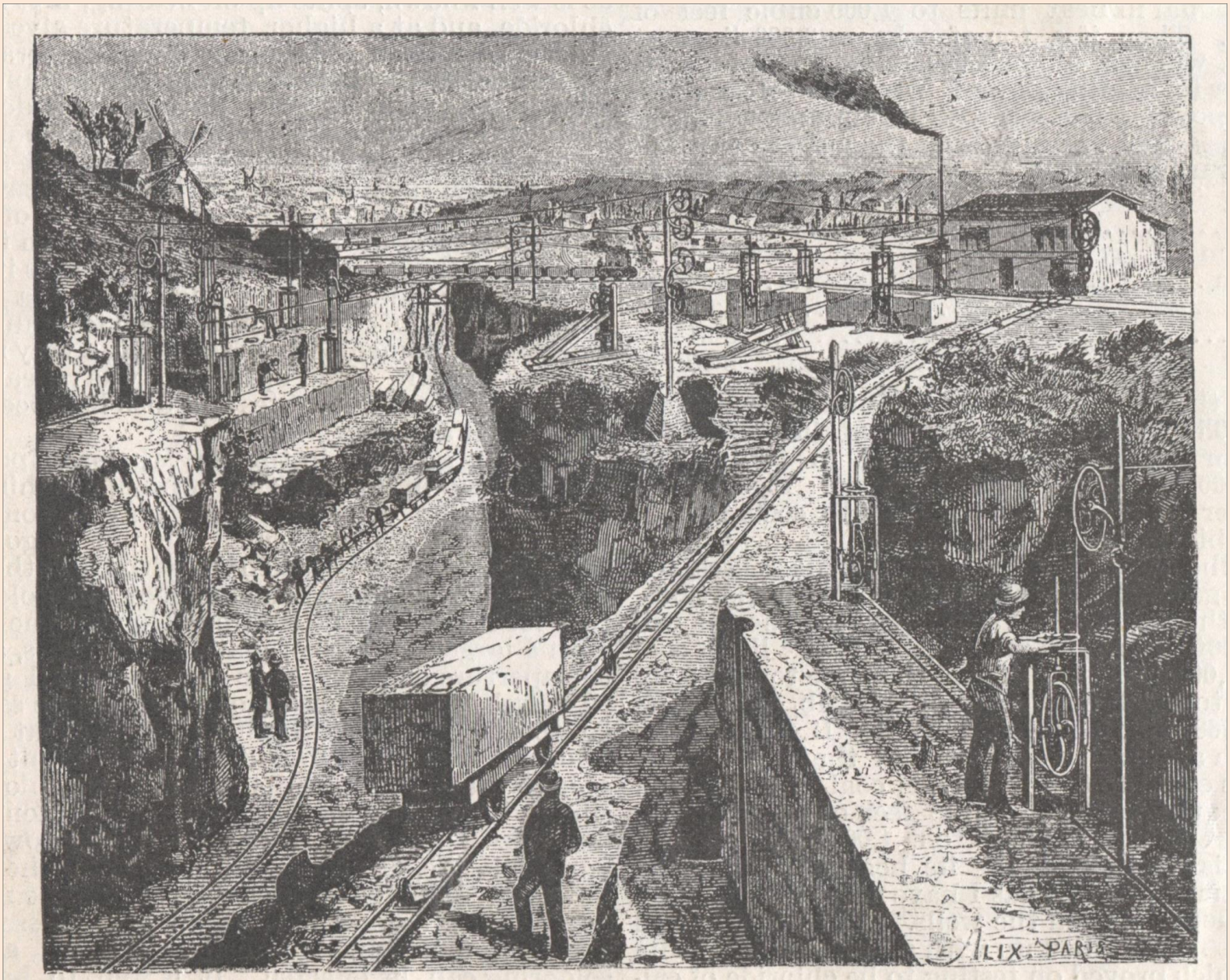


FIG. 5.—APPLICATION OF GAY'S STONE SAW IN A MARBLE QUARRY.

Fig. 5. Application of Gay's Stone Saw in a Marble Quarry" (in Belgium)

"*Tubular Perforators*. – Mr. Gay has rendered his saw completer by the invention of a tubular perforator for drilling the preliminary well. It is based upon the same principle as the Leschot rotary drill, but differs from that in its extremity being simply of tempered steel instead of being set with black diamonds. A special product, called metallic agglomerate, is used instead of sand for hastening the work.

"The apparatus, Fig. 6, consists of an iron plate cylinder, A, 27 ½ inches in diameter, and of variable length, according to the depth to be obtained, and terminating beneath in a steel head, B, of greater thickness. This cylinder is traversed by a shaft, C, to which it is keyed, and which passes through the center of the aperture drilled. This shaft is connected with the cylinder, A, through the intermedium of-cross-bars, D, and transmits there to a rapid rotary motion, which is received at the upper part from a telodynamic wire that passes through the channel of the horizontal pulley, P. This latter is supported by a frame consisting of three uprights, Q Q, strengthened by stays, R R, fixed to the ground.

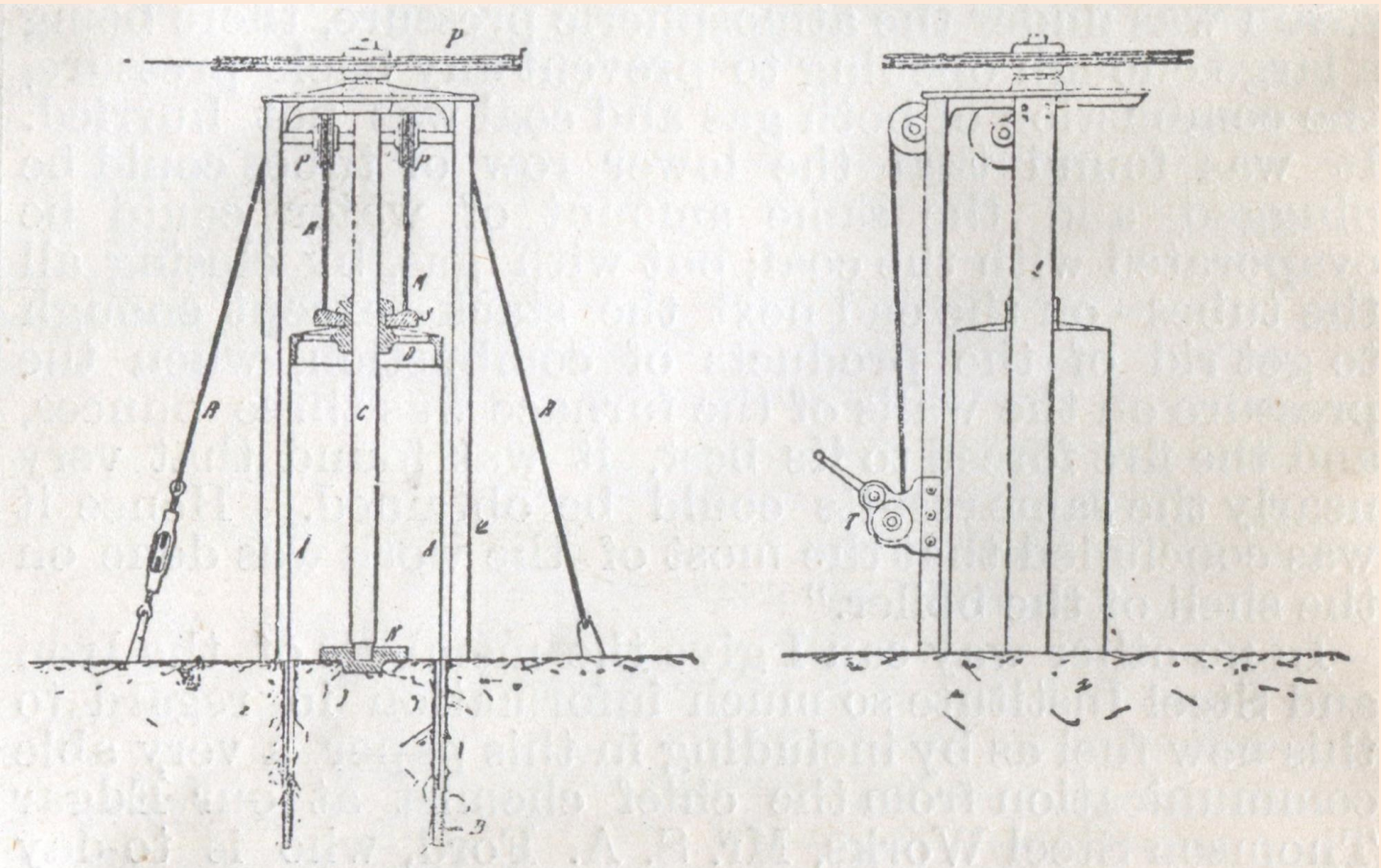


FIG. 6.—TUBULAR PERFORATOR.

"In order that the cylinder, A, may be given a vertical motion, cords, M M, fixed to a piece, S, loose on the hub, D, wind round the drum of a windlass, T, after passing over the pulleys, *p p*.

"The rapid gyratory motion of the cylinder, along with the erosive action of the metallic agglomerate, rapidly wears away the rock, and causes the descent of the perforator. During this operation a core of marble forms in the cylinder. This is detached by lateral pressure, and is capable of being utilized. The tool descends at the rate of from 20 to 24 inches per hour, or from 8 to 10 yards per day in ordinary lime rock. – *Le Genie Civil*."