2 Sheets--Sheet 1.

G. M. MOWBRAY.

Frictional Electrical Machine.

No. 162,676. Patented April 27, 1875.

Fig. 1.

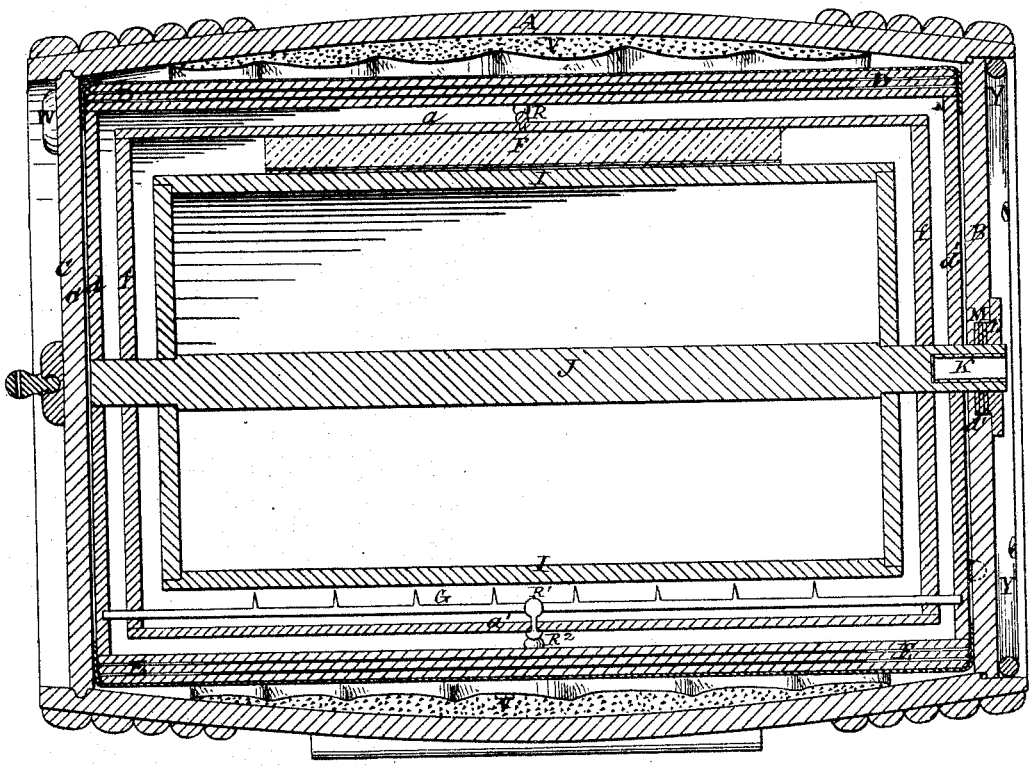
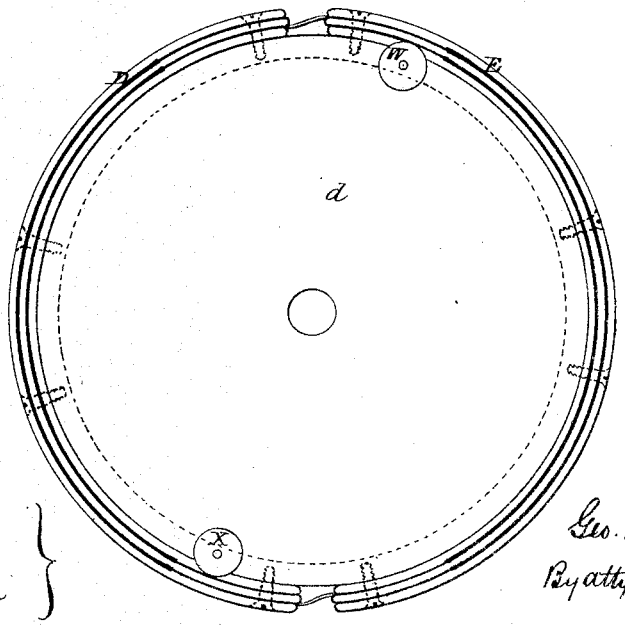


Fig. 3.



Witnesses.
W. E. Clapp
Edmund Masson

Inventor.
Geo. M. Mowbray.
By atty A. B. Stoughton.

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2 Sheets--Sheet 2.

G. M. MOWBRAY.

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No. 162,676. Patented April 27, 1875.

Fig. 2.

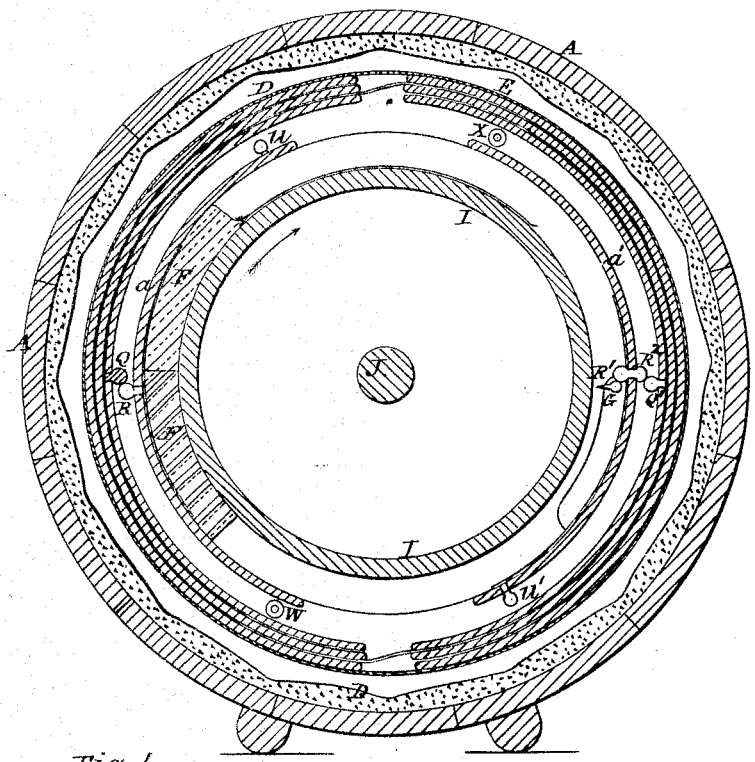


Fig. 4.

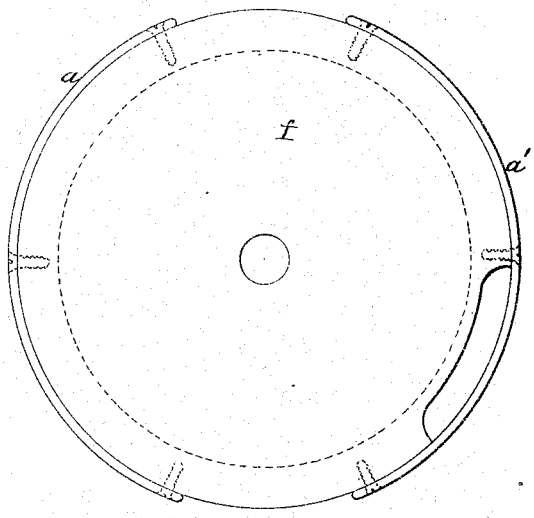
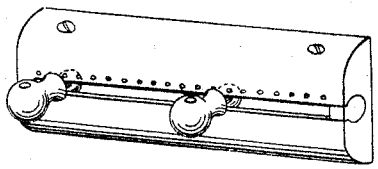


Fig 5.



Witnesses.

W. B. Shaffer

Edmund Masson

Inventor.

Geo. M. Mowbray,

By Atty A. B. Stoughton

UNITED STATES PATENT OFFICE.

GEORGE M. MOWBRAY, OF NORTH ADAMS, MASSACHUSETTS.

IMPROVEMENT IN FRICTIONAL ELECTRICAL MACHINES.

Specification forming part of Letters Patent No. **162,676**, dated April 27, 1875; application filed November 30, 1874.

To all whom it may concern:

Be it known that I, GEORGE M. MOWBRAY, of North Adams, in the county of Berkshire and State of Massachusetts, have invented an Improved Frictional Electric Battery, of which the following is a specification:

The nature of my invention relates to portable electric machines used for blasting, firing mines, torpedoes, &c.; and the improvements I have made are, first, a better relative arrangement of the several parts, securing, in less space, a higher potential and greater quantity of electricity; second, a cheap and simple accumulator capable of being readily repaired in case of perforation by overcharge; third, modification of the rubbing-surface whereby deterioration of the exciting-surface is prevented; fourth, neutralizing the damaging influence of a damp atmosphere, heretofore so disturbing in these machines; fifth, a device which cuts off both collector and rubber from the accumulator the instant a charge has been accumulated, before discharging same, thus obviating loss by dissipation from the collecting-points and rubber; sixth, a test-gage, by which the operator can determine beforehand with precision the number of mines the machine is capable of firing, by any given number of turns of the crank, and thus be assured of the efficiency of the machine for the work required.

For the sake of brevity I propose in this specification to describe my improvements as applied to a cylinder-machine; but any one skilled in the art can adapt them to either a plate or a spherical exciting-surface by simply conforming the shapes of the various parts to that form of exciting-surface he may prefer.

The apparatus may be divided into five principal parts, commencing outside and proceeding toward the center. These are, first, a water-tight inclosing-case, mounted with the test-gage, carrying handle, standard-rests, and lined with a drying-pad or cushion; second, a stationary cylindrical frame, consisting of the accumulator, in two parts, a collector, and two insulating hollow rods, containing the discharging-sockets; third, an oscillating frame carrying the rubber and the charging and discharging devices; fourth, an exciting-surface, and in this specification a cylinder of hard rubber will be described; fifth, a prime mover or arbor with crank.

The drawings to illustrate this specification are five in number, viz: Figure 1, longitudinal section; Fig. 2, cross-section; Fig. 3, plan of the disks *d d'*; Fig. 4, plan of the disks *f f'*; Fig. 5, test-gage.

Similar letters apply to similar parts in each figure.

A, case with handle and standards; B, head resting on a shoulder cut in staves; C, bottom, mounted with test-gage and discharging-socket; D, one of two twin semi-cylindrical accumulators; E, the other twin semi-cylindrical accumulators; *d d'* two disks, Fig. 3, on whose periphery the accumulators D and E being fixed, form the stationary cylindrical frame (or part 2) of the apparatus; F, the rubber or cushion with silk flap; *a*, vulcanite shield, carrying the rubber F and the metal projections R and U, Fig. 2; *a'*, vulcanite shield, carrying the metal projections R^1, R^2, and U'; *f f'*, two disks, Fig. 4, on whose periphery the vulcanite shields *a a'* are fixed. A recess is cut in the rim of these disks, occupying sixty degrees of their circumference to limit their movement. G, the collector, held between disks *d d'*; I, hard rubber exciting-cylinder, with closed or partially-closed ends, attached to the arbor; J, arbor, or prime mover, made of hard rubber. This supports or serves as a bearing for the oscillating disks *f f'* and bears itself on the disks *d d'*. K, metal square crank socket inserted in arbor; L, brass bearing for arbor, screwed into head B, confines the packing-ring M against disk *d'*; M, soft vulcanized-rubber packing-ring; Q, metal projection connecting concave of the dielectric D. Q', metal projection to concave of dielectric E; R, metal projection on shield *a*, connecting the rubber F with the dielectric of accumulator D; R^1 R^2, metal knobs on and through shield *a'*, connecting G to E; U, metal projection in communication with R; U', metal projection in communication with R^2; V, exsiccating-cushion, packed with quicklime and mica scales; W, hollow tubular discharge-sockets to receive mine-wire; X, hollow tubular discharge-sockets to receive mine-wire; Y, re-

taining-ring for head of inclosing-case, with an elastic rubber hollow tube beneath to render joint water-tight.

The case for a cylinder-machine may be constructed like a powder-keg. In order, however, to get at the apparatus within readily, either for cleaning or repair, the head B of the keg A, Fig. 1, rests on a shoulder, turned out of the staves, and is fitted with a packing-box, L, to receive the prime mover or arbor J, packed with a soft-rubber ring, M, to render it water-tight. In the head of the arbor J a square metal socket, K, is sunk to receive the crank. Keyed or pinned onto the arbor J is the exciting surface or cylinder I, and outside of this cylinder, and surrounding it, is another cylindrical frame, built up of the two disks *f f'*, which oscillate on the arbor J, and support the two semi-cylindrical shells *a a'*. Shield *a* carries the rubbing-cushion F, and connected thereto, and with each other, are the metal projections R and U. The other shield, *a'*, carries the two knobs R^1 and R^2, united through the shield *a'*, and form a path for the electricity from the collector G, while accumulating to the concave side of the dielectric E, by communicating with the knob Q^1. Outside of the oscillating cylindrical frame just described is a third cylinder, which is stationary, being composed of the two twin accumulators D and E, by fastening these onto the peripheries of the two disks *d* and *d'*, which are further held in place by the collector G and by two hard-rubber rods, which pass out and through flush with the bottom C of the keg A. These rods are bored about half-way down their length, so as to receive metal wires, which have hollow terminal sockets to receive the leading and return wires to and from the mine, and connect them with the apparatus. I term these discharge-sockets W and X. The arbor or prime mover has three bearings on disks *d* and *d'*, respectively, and on and through the stuffing-box I, and in its turn the prime mover serves as a central bearing for the disks *f* and *f'* to oscillate upon. The hard-rubber rods, which contain the discharging-sockets, and the brass wire running within same about half-way down, are filed away, so as to expose the brass wire within, so that when these bared portions of the brass wire are touched by the knobs R and R^2 they serve to discharge the accumulators as follows: from D on its concave side knobs Q, U, R and W open a path for the + E of the rubbing-cushion, and from E on its concave side knobs Q', U', R^2 and X open a path for −E from the collector to the mine-wires, respectively. The concave side of the dielectric D (assumed in this specification to receive +E) is in metallic connection with the convex surface of the dielectric E, and becomes charged with electricity of the same sign—viz., +E—while, vice versa, the concave side of the dielectric E, charged with −E, is, in like manner, in metallic connection with the convex surface of the dielectric D, which necessarily, therefore, becomes charged with −E. Thus the concave surface of each accumulator presents to the concave surface of the other an opposite sign of electricity, and this arrangement arrests dissipation of electricity from what is termed by electricians "creeping," so that I am enabled to accumulate electricity of a higher potential than would otherwise be possible with the same limits of space and area, and has never heretofore been applied in frictional electric machines.

The accumulators (condenser or Leyden jar) consist, each of them, of a semi-cylindrical inner dielectric, being a thin sheet of hard rubber, armed with a metal conducting-surface on each side, of less area than the dielectric itself, and a protecting or insulating sheet of either hard rubber or pure soft rubber, of the same area and curve as the dielectric, on each side thereof, and over all a sheet of pure soft rubber, so as to completely envelop the same. I use two of these accumulators, for the reason hereinbefore specified, viz: to arrest creeping, by offering, the one to the other, a surface of opposite sign of electricity, and this enables me to secure a charge of higher potential. I am aware that a condenser has been formed of plastic rubber and sulphur rolled into sheets, and metal between, then pressed in a hydraulic press, to exclude air, transferred to a mold, and baked in an oven for several hours, at particular temperatures, which must be carefully observed until the compound known as hard rubber, ebonite, or vulcanite is produced. A comparison of this kind of accumulator with that which I have described will enable any one to judge of their respective merits as regards, first, cost, simplicity of construction, and possibility of repairs, &c. My process enables me to select a sheet of rubber without flaw or points, and of a polished surface, while if an accumulator formed in the plastic state and then vulcanized be cut through, the surface of the inside sheets will be found corrugated, with lines marked thereon caused by the metal, for, as the circumference shrinks more than the diameter, the metal crimps up, and renders the dielectric peculiarly liable to fracture when highly charged. All these defects my method avoids. In case of a perforation occurring, the condenser prepared by baking the plastic material is of no use, whereas if a like accident occurs to the form I have described, the injured sheet can be removed and replaced, and the other parts are used again. If greater accumulating-surface is needed than is furnished by one pair of dielectrics, then a second is added, metalled as previously described, with an intervening sheet of hard or soft rubber interposed between the two, and the envelope of pure soft rubber is made to surround the two dielectrics, instead of simply the one, in manner as before described. My method diminishes the cost of an accumulator

of like area of dielectric, fully three-fourths, and in no way diminishes its effective capacity.

Exsiccator.—Attached to the inner surface of the case, and outside of the accumulators, is a cushion formed of silk or any permeable insulating material, which is packed with any drying materials capable of rendering air anhydrous. I prefer for this purpose a mixture of fresh-burnt quicklime and dry mica scales. These last, being dry and feathery, allow space for the increase of bulk as the lime slakes, without the risk of bursting the envelope. By this device the atmosphere within the case is rendered and maintained perfectly suited for exciting, collecting, and storing the electricity developed, independent of the state of the weather outside the case.

The Rubber.—I construct my rubbing-cushion so as to present to the exciting or rubber surface of the cylinder-plate or sphere two distinct rubbing-surfaces, (exclusive of the silk flap introduced by Dr. Nooth in 1774,) the one, an oiled silk or resinous surface to receive the amalgam; the other, a filamentous, felted, or velvety surface, free from amalgam, or nearly so, and next to this follows the protecting silk flap, extending almost to the collector. As the exciting-surface moves forward, first passing over or under the amalgam-surface, electricity is developed, and next as it passes under the filamentous surface, the loose particles or amalgam-dust are detained, all specks and conducting streaks adherent to the exciting-surface are removed, and the charged electric surface goes forward beneath the flap, clean and polished anew at each revolution.

Graduated Test-Gage.—Outside the case, at the end farthest from the crank, I attach a gage made of hard rubber, into which are inserted at intervals—say, of one-twelfth of an inch from each other—a row of metallic points or pin-heads. At one extremity of this graduated scale of points is a fixed standard of metal, with an eye to receive one of the terminals from one of the discharge-sockets. At the other extremity of the row of points is a movable standard, of metal, with an eye to receive the other terminal wire from the other discharge-socket. This latter standard moves in a groove or slotted tube, along or over the points, connecting with them as it is passed along.

By connecting wires from the discharging-sockets to these standards, and regarding each interval between the points as representing the interval or solution of continuity of each exploder, the operator can determine, before firing his mine, the efficiency of his machine, by noting the number of turns requisite to fire any number of intervals on this graduated scale.

Mode of Operating the Battery.—Assuming that the machine has just been discharged by a reverse movement of the crank; now, in order to recharge, turn the crank in the direction of the hands of a watch one-sixth of a revolution, or sixty degrees. The friction between cylinder and rubbing-cushion moves the rubber forward until the end of the slot in the disks *f f'* strikes against the collector-rod G. This brings the position of the various knobs as shown in Fig. 2, viz: The rubber-knob R abuts on the dielectric knob Q; the collector-knob R^1, on the concave of shield *a'*, abuts on the collector-knob G; the knob R^2, on the convex of shield *a'*, abuts on the dielectric knob Q'. By continuing the revolutions, +E from rubber F passes, via knobs R and Q, to the concave side of dielectric D, and this being in permanent connection with the convex surface of dielectric E, necessarily it follows that these two surfaces are being charged with +E. Simultaneously, —E passes from the collector G, via the collector-knobs R^1 R^2, to the dielectric knob Q', charging the concave surface of dielectric E and the convex surface of dielectric D, since these two surfaces are in permanent connection with —E.

When a sufficient charge of electricity has been accumulated on the several surfaces, a slight reverse movement of thirty degrees only of the crank, by the friction of the cylinder against the rubber, moves the rubber frame and shields *a a'* backward, the effect being that knob R on shield *a* leaves knob Q on the rubber side; and on the collector side R^1 leaves the collector; R^2 leaves the dielectric knob Q, so that the accumulators are now left charged and insulated and ready to fire. A slight reversal thirty degrees farther of the crank, carries knob *u* on the rubber side to Q, and knob R to discharge-socket W, opening a path from the surfaces of the dielectrics charged with +E, or rubber side, to W. Simultaneously, knob U' on the collector side has moved up to the fixed knob Q' of the dielectric E, and knob R^2, in permanent connection with U', passes up to the discharging-socket X, thus opening a path from the dielectrics that are charged with —E, from the collector side to the discharge-socket X. Assuming that the terminals of the wires in sockets W and X are within striking distance, discharge ensues with a loud snap.

The Arbor or Prime Mover.—In all portable batteries used for blasting, heretofore made, the arbor is of metal, and when the charge is raised to a high potential, on effecting discharge a severe shock passes through the operator's body. I remedy this by constructing my arbor of vulcanite, sinking a square metal socket to receive the crank, and fitting a ferrule of brass around to strengthen the part that passes through the stuffing-box. This enables me to confine the arbor flush with the head of the case, and thereby protect the same from injury.

Lastly, elastic wires connect knobs U and R, and similarly knobs U' and R^2. These serve to cushion the shock if an operator dis-

charges the battery violently, reversing the crank.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The arrangement of a frictional exciting-surface between two curved dielectrics, both of these curved dielectrics having on each surface, respectively, metal armatures with sufficient marginal insulation to form a condenser, the inside surface of one of them so situated during excitation as to receive electricity from the rubber, while the inside surface of the other curved dielectric simultaneously receives electricity from the collector, and withal the inner surface or armature of each one being in connection with the outer surface or amature of the other, substantially as described.

2. The accumulator or Leyden jar, of any preferred shape, built up of sheet hard rubber and metal plates, insulated from external influence by other sheets of hard rubber, and enveloped in pure sheet rubber, substantially as described.

3. An electric rubbing-cushion, formed of two distinct surfaces, the one resinous, to receive the amalgam and excite electricity, the other filamentous, felted, or velvety, to cleanse and polish the exciting-surface with the usual oiled or varnished silk flap, substantially as described.

4. The combination of an exsiccator, composed of a material capable of absorbing moisture from the atmosphere, packed in a permeable envelope, with a frictional electric machine in a water-tight case, substantially as described.

5. The oscillating cylinder, independent of the condenser, which is stationary, composed of two disks, each having a slot cut out of its periphery for about sixty degrees, carrying two semi-cylindrical sheets of hard rubber, there being affixed to one of these the rubbing-cushion and its conducting-knob, to the other a knob projecting through it, this oscillating cylinder admitting of a determinate limited motion from the rotation of the exciting-surface, the range of oscillation being determined by the collecting-rod, which is stationary, and passes through the slots of the disks, serving a triple purpose, viz: First, isolating the condenser from the rubber collector and lead wires when it receives a thirty-degree reverse motion; second, discharging the battery through the leading and return wires when this reverse motion is continued to sixty degrees of a circle; and, third, conducting the charge from the rubber and from the exciting-surface to the condenser by a forward motion of sixty degrees, substantially as described.

6. The graduated test-gage, with sliding or movable standard and connections for terminal wires, substantially as described, and for the purposes set forth.

7. The hard-rubber shaft of a frictional electric-machine, with sunken socket for crank, substantially as described, and for the purposes set forth.

8. The elastic-wire connections between the knobs moving and the fixed knobs of a frictional electric-machine, for the purpose of cushioning violent movement, substantially as described.

9. The combination of a rotating exciting-surface, an independent oscillating frame, carrying a rubber and connecting-knobs, with a stationary collector and a stationary condenser, all inclosed in a water-tight case or keg, substantially as described.

GEO. M. MOWBRAY.

Witnesses:
HARRY S. MOWBRAY,
JAMES WHITE.