[Second Edition.]

A.D. 1870, 1st *August.* N° 2147.

# Cutting and Grinding Stone, &c.

LETTERS PATENT to Alfred Vincent Newton, of the Office for Patents, 66, Chancery Lane, in the County of Middlesex, Mechanical Draughtsman, for the Invention of "IMPROVEMENTS IN CUTTING, BORING, GRINDING, AND PULVERIZING STONE AND OTHER HARD SUBSTANCES."—A communication from abroad by Benjamin Chew Tilghman, of Philadelphia, in the State of Pennsylvania, United States of America.

Sealed the 20th December 1870, and dated the 1st August 1870.

PROVISIONAL SPECIFICATION left by the said Alfred Vincent Newton at the Office of the Commissioners of Patents, with his Petition, on the 1st August 1870.

I, ALFRED VINCENT NEWTON, of the Office for Patents, 66, Chancery Lane, in the County of Middlesex, Mechanical Draughtsman, do hereby declare the nature of the said Invention for "IMPROVEMENTS IN CUTTING, BORING, GRINDING, AND PULVERIZING STONE AND OTHER HARD SUBSTANCES," to be as follows:—

This Invention relates to the cutting, boring, and grinding of stone, metal, glass, and other hard substances, by means of a stream of sand

(of quartz or other suitable material,) driven rapidly against them by a jet of steam, air, water, or other suitable gaseous or liquid medium. The greater the pressure of the gaseous or liquid jet the higher will be the velocity imparted to the particles of sand, and the greater their cutting effect upon the hard substances. The harder, specifically heavier, and sharper the grains of the sand, the greater will be their cutting effect. At a higher velocity of impact the grains of the sand will cut or wear away substances much harder than the material of which the sand is composed. When the sand used is of a brittle nature, such as quartz, emery, or similar substances, the grains are broken by the shock into fine powder, and the process may thus be used as a method of pulverization. By varying the shape of the jets, and moving them or the stone, cuts or holes of any shape or size may be made.

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**SPECIFICATION** in pursuance of the conditions of the Letters Patent filed by the said Alfred Vincent Newton in the Great Seal Patent Office on the 1st February 1871.

**TO ALL TO WHOM THESE PRESENTS SHALL COME,** I, ALFRED VINCENT NEWTON, of the Office for Patents, 66, Chancery Lane, in the County of Middlesex, Mechanical Draughtsman, send greeting.

**WHEREAS** Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the First day of August, in the year of our Lord One thousand eight hundred and seventy, in the thirty-fourth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Alfred Vincent Newton, Her special licence that I, the said Alfred Vincent Newton, my executors, administrators, and assigns, or such others as I, the said Alfred Vincent Newton, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVEMENTS IN CUTTING, BORING, GRINDING, AND PULVERIZING STONE AND OTHER HARD SUBSTANCES," being a communication to me from abroad by Benjamin Chew Tilghman, of Philadelphia, in the State of Pennsylvania, United States of America, upon the condition (amongst others)

that I, the said Alfred Vincent Newton, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said Alfred Vincent Newton, do hereby declare the nature of the said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement, reference being had to the Drawing hereunto annexed, and to the letters and figures marked thereon (that is to say):—

This Invention as communicated to me by my foreign correspondent relates to the cutting, boring, grinding, dressing, and pulverising of stone, metal, glass, wood, and other hard or solid substances by means of a stream of sand, or grains of quartz, or of other suitable material artificially driven, as projectiles rapidly against them by a jet of steam, air, water, or other suitable gas or liquid, which jet may be made to ornament glass and other polished surfaces by partially depolishing such surfaces so as to produce any desired pattern thereon.

The following is the description of the process as communicated to me:—The greater the pressure of the jet the higher will be the velocity imparted to the grains of sand, and the more rapid and powerful their cutting effect upon the solid substance. At a high velocity of impact the grains of sand will cut or wear away substances much harder than themselves, corundum can thus be cut with quartz sand, and quartz rock can be cut or worn away by small grains or shot of lead, I have sometimes used iron sand composed of small globules of cast iron.

By the term sand in this Specification I mean small grains or particles of any hard substance of any degree of fineness, of which common quartz sand is a type. The hardest steel, chilled cast iron, or other metal can be cut or ground by a rapidly projected stream of quartz sand. Articles of cast or wrought metal may have their surfaces thus smoothed and cleaned from slag, scale, or other incrustation, and this method of cleaning may be used in preparing metals for being tinned, zinced, enamelled, or coated with metallic or other substances. The surfaces of wrought stone, in buildings or elsewhere, can thus be cleaned and

refreshed. By means of stencil plates, screens, or suitable covering substances, letters or designs can thus be cut or engraved upon hard substances. By varying the shape, number, and direction of the projected streams of sand, and by giving to them and to the articles treated suitable movements by means of lathes, planing or drilling machines, or other known mechanical devices, cuts or holes may be made of any shape or size. When sand of a brittle nature, such as quartz or emery, is very rapidly projected against a hard material, the grains are broken by the shock into fine powder, and the process may thus be used as a method of pulverization. Where a jet of water under heavy pressure is used, as in hydraulic mining, the addition of sand will cause it to cut away hard and close grained substances, upon which the water alone would have little or no effect. Pebbles or stones of size and weight as great as can be rapidly projected by the jet of water used will have a battering, penetrating, and dislocating effect which will assist the disintegrating and scouring action of the water.

Heretofore when sand has been used as a grinding or cutting material it has been applied between solid substances moved over each other under heavy pressure so as to make a series of strokes as in the ordinary cutting of stone and glass, or else in a solidified form as in a grindstone or sand paper, or sometimes in a semi-fluid state as when a body is rubbed or moved in a mass of sand.

The peculiar feature of my Invention, which distinguishes it from other methods of cutting and grinding, is that each grain of sand acts by its own velocity and momentum like a bullet or projectile, and pulverizes, cuts, or indents the object it strikes. From this peculiarity of action it results that some substances which though comparatively soft are also tough or malleable or elastic, and not pulverizable by a blow such as copper, lead, paper, wood, or caoutchouc, for example, are less rapidly cut and ground by the sand blast particularly at moderate velocities, than some much harder substances which are brittle or pulverizable such as stone, glass, or porcelain. Another peculiarity of the sand blast is that the grinding or cutting action takes place upon irregular surfaces, cavities, corners, and recesses, hardly accessible to ordinary methods. I believe that steam will generally be found the most convenient impelling jet, particularly for high velocities, but in some localities air or water may be cheaper. I have used steam of all pressures, sometimes exceeding four hundred pounds per square

inch, and have found its efficiency to increase with the pressure. I believe that when it is desired to cut or grind hard substances rapidly it will be advantageous to use steam of as high pressure as can practically be made available, but each operator can choose the pressure most convenient for his circumstances and the kind of work he wishes to do.

The following is a method of carrying my Invention into effect, taking, for example, the cutting of stone by means of quartz sand projected by a jet of steam of about three hundred pounds pressure per square inch.

In the accompanying Drawing Fig. 1 shews in partial section the arrangement of jet apparatus employed in carrying out the Invention.

The sand is fed into a funnel *a*, which is connected by a flexible tube and turning point *b* with an iron or steel tube *c*, *c*, of any convenient length and of about seventeen-hundredths of an inch bore, which I call the sand tube; this tube is firmly secured exactly in the centre of another iron or steel tube *d*, *d*, of about one-half inch bore, which I call the steam tube. The interval between the tubes is closed at one end *e*; at their other ends both tubes are brought to the same length, but the bore of the outer tube *d* is here contracted to a diameter of twenty-six-hundredths of an inch for about one quarter of an inch from its end, and about half an inch of the end of the inner tube *c* is reduced to a cylinder of twenty-three-hundredths of an inch external diameter, so as to leave between the ends of the tubes a smooth regular annular opening *m*, *m*, of about fifteen-thousandths of an inch in width, continuing of this size for about a quarter of an inch in length and then enlarging gradually to the full diameter of the steam tube; this annular opening *m*, *m*, forms the passage for the escape of the steam. The steam tube *d* is connected with the steam boiler by the holes *f*, *f*, the T piece *g*, the stuffing boxes *h*, *h*, *h*, and the jointed pipes *o*, *o*, *o*, so as to allow it to be rotated and moved in any direction. A wrought or chilled cast iron or steel tube *i*, *i*, which I call the nozzle tube, about thirty-eight-hundredths of an inch in bore and six inches long is fastened on the end of the steam tube. The end of the sand tube *c* is accurately adjusted and firmly fastened exactly in the centre of the steam tube *d*, so that the annular opening is everywhere of the same width, and the nozzle tube is adjusted so that its axis or central line coincides perfectly with the axis of the steam jet issuing from the annular opening. The perfect accuracy of these adjustments is important. The bore of the nozzle tube is adjusted by trial to the size and pressure of the steam jet so as to produce the amount of suction

desired in the sand tube. For the sake of brevity the stream of sand impelled by the jet of steam, air, &c., will herein be called "the sand blast," and the system of tubes for producing it will be called "the blast pipe." The sand used should be sifted of even size, and should be clean, hard, sharp, and dry, so as to run regularly through a small hole without clogging. I have found sand which will pass through a sieve of forty wires per inch and not through one of forty-eight wires to cut faster than sand which will pass through a sieve of twenty wires and not through one of thirty wires to an inch. The steam should be dry and free from condensed water. When used at a distance from the boiler a steam separator or purger should be used such as is well known to engineers and the pipes kept well wrapped.

The operation is as follows:—The steam is turned on and issues with great velocity from the annular opening *m*, *m*; this creates a suction and current of air in the sand tube *c*, *c*. A sliding valve in the bottom of the sand box is now opened and lets a stream of sand of from one to two pints per minute fall into the funnel *a*, whence it is carried by the current of air through the sand tube, and is sucked into the jet of steam and driven by it through the nozzle tube, acquiring a high velocity, and finally strikes against the stone to be cut, which is held about an inch distant from the end of the nozzle. The shattered fragment of the sand and stone, partly in very fine powder, and the waste steam escape sidewise and backward. A dull red light may be seen at the point of impact of the sand and stone. If the sand blast is kept directed steadily at the same spot a hole will gradually be cut, the diameter of which at the surface is greater than that of the steam jet, but which grows smaller and becomes conical as it penetrates deeper into the stone.

I have observed that this tendency to form a conical hole increases with the hardness of the substance operated on, and that it diminishes as the pressure and velocity of the blast is increased. To make a hole or cut with parallel sides I have found that the blast should be slightly inclined toward each side alternately. The angle of inclination will vary with the hardness of the stone and the pressure of the jet used.

In cutting granite with a steam jet of about three hundred pounds pressure per square inch, I have found an inclination of about one in nine to make a parallel cut. Operating on rather soft burnt brick with the same jet, without inclination, the sides of the cut were almost parallel. Sufficient space must always be allowed for the escape of the current of

waste steam and sand, and consequently when a deep hole is to be cut its diameter must be great enough to admit this escape around the blast pipe when it is advanced to near the bottom of the hole.

In cutting holes I have found it convenient to use a blast pipe bent at a point about two inches back of the annular jet to an angle of about one in nine, and to use a nozzle tube only about two inches long. The blast pipe being directed as above indicated successively to all parts a hole of any shape can be cut with parallel sides, or the sides may be undercut so that the hole will be of greater diameter at the bottom than at the top, chambers for blasting powder may thus be made.

In cutting long narrow grooves I have found it convenient to arranged parallel guide plates of iron or steel *n*, *n*, (see detached view Fig. 1ª) about one and a half inch wide and projecting about three inches from the end of the nozzle tube, leaving between the plates a space equal in breadth to the bore of the nozzle tube. The effect of these plates is to prevent the sand blast from diverging, and to make the edges and surface of the groove more even and regular.

In dressing stone so as to produce a flat surface I have found it convenient to cut first a narrow groove about half an inch deep, and then to break or split off the overhanging edge, and then continue or deepen the groove, and break off the new overhanging edge, and so on. When the stone varies in hardness in different spots the workman must keep the blast directed upon the hard spots until he sees that they are worn down to the desired level, and must pass it quickly over soft spots as soon as he sees they are sufficiently cut. As most kinds of stone contain frequent alternations of hard and soft spots constant care and attention must be given by the operator to obtain an even surface. A sheet iron guard or shield is arranged to protect the face and eyes of the workman from the rebounding sand, and a narrow slit in it enables him to watch and regulate the progress of the operation. Suitable movements are to be given to the blast pipe or to the stone, or to both, by hand or by any suitable machinery so as to produce the shape of cut desired. If the axis of the nozzle tube and guide plates does not coincide accurately with that of the steam jet they will be rapidly cut away by the sand blast. If any obstruction from dirt or scale chokes up one side of the annular opening of the steam jet the sand blast will be distorted sidewise and will rapidly cut away the nozzle tube. Even under good conditions the sand blast will gradually cut away the nozzle tube, which must be

watched and renewed when required. Instead of an annular impelling jet having the sand introduced in its centre I have sometimes used a central impelling jet and introduced the sand by an annular tube surrounding the impelling jet.

I have found the above described method of introducing the sand into the impelling jet by means of the suction produced by the jet itself to give good results, but it is to be understood that I do not confine myself thereto. I am aware that part of the pressure of the jet is thereby lost, but I think the practical convenience counterbalances this loss, I have sometimes used a strong close vessel to contain the sand, and introduced a current of the steam, air, or water under pressure, above the sand, and then by suitably regulating the cock on the pipe leading to the top of the close vessel and the cock on the pipe leading to the impelling jet a current of the fluid can be made to pass through the close vessel and carry with it any desired quantity of sand into the impelling jet. When steam is used in this manner the close vessel must be kept hot enough to avoid the condensation of water among the sand which would prevent its running through the pipes. × A current of air forced into the close sand box at a pressure greater than that of the steam employed may also be used as a means of conveying the sand into the impelling steam jet. I have observed that the quantity of stone cut by a given sand blast in a given time is much greater when ample space for free escape is afforded to the sand and steam after they have struck the stone than when the space for escape is narrow and confined. When a rapid lateral motion is given to the blast pipe or to the stone so that the sand is constantly striking upon a fresh surface a much greater cutting effect is produced than when the blast is kept pointed at one spot. In the latter case it appears that the sand and steam rebounding back from the stone interfere considerably with the fresh sand which is being projected toward the stone. This interfering effect is particularly evident when a hole is cut but little larger than the diameter of the sand blast. I have noticed that when a sand blast is held at four or five inches distance from a stone a greater quantity will be cut than when the same sand blast is held at but one inch distance. Also that when a sand blast is directed at an angle of from thirty to forty-five degrees with the face of a stone a greater quantity will be cut than when the same sand blast at the same distance (one inch) is directed at an angle of ninety degrees with the face of the stone.

The divergence of the sand blast spreading it over a wider surface of the stone and also giving it more room to escape, and thus to avoid interference with the oncoming sand appears to be the explanation in these cases. But I have found that in cutting a narrow groove more progress is made by keeping the blast pipe directed square at the stone and keeping the stone as close to the guide plates as its shape will permit, for although the gross quantity of stone cut away may be less than at a greater distance the effect is more concentrated and confined to the desired spot and direction. The quantity of sand to be used with a given steam jet may be considerably varied according to the object desired. When a soft stone is to be cut over a wide surface, so that a free sideway escape can be given, a quantity of sand two or three times as great as above described may be used, but where a hard stone is to be cut in a narrow groove a small feed of sand produces a better result.

I have found the proportions, size, and arrangement of tubes composing the blast pipe above described to give good results in practice under the conditions mentioned, but I do not mean to confine myself thereto as they will vary according to the pressure of the jet used, and the kind of work to be done in order to obtain the best results in economy of power and time. The principal points to be attended to are, first, to get an impelling jet of great velocity; second, to feed the sand regularly and in such a manner as to acquire as nearly as possible the velocity of the impelling jet; third, to direct the projected sand upon the desired spot without wasting its force in wearing away the nozzle tube; and, fourth, to provide free escape for the expended steam and sand so as to avoid back pressure and interference. For purposes where only a small quantity of material is to be cut or ground away from the surface of a hard substance, and where only a moderate velocity of the sand is required, I have found the current of air produced by the ordinary rotary fan to be convenient. I have used this method for grinding or depolishing glass, china, or pottery, either on entire surfaces or on surfaces partially covered and protected so as to produce an engraving of letters, ornaments, or designs. In engraving designs air is more convenient than steam as an impelling jet in this respect that the sand keeps dry and rebounds leaving the pattern clear, while with steam the sand becomes damp and is apt to adhere to and clog the fine lines and corners. The sand being fed into the air current by its own

pressure in a column of sufficient height is carried along by the air in a tube or close trunk, and strikes upon the glass which is held or moved opposite the mouth of the trunk, and cuts, grinds, or stars its surface.

One arrangement which I have found convenient for flat glass is shown in longitudinal and transverse section in Figures 2 and 3 of the Drawing, but I do not confine myself thereto, as the mechanical arrangements may be varied. The air current from the fan of about the pressure of four inches of water is brought by the trunk *a*, *a*, (about one foot high and two feet wide) and descends into the narrow vertical tube *b*, *b*, (about two feet high and of a cross section of about sixty inches long by one inch wide) from the lower end of which it rushes with a velocity proportioned to its pressure. Into the upper end of the tube *b*, *b*, the sand is evenly fed from the sand box *c* by means of the sand tube *d*, *d*, (about one foot high and of a cross section of sixty inches by one half inch), the lower end of which is closed by an iron plate perforated with holes about a quarter of an inch in diameter, and half an inch apart, so as to supply about fifteen or twenty cubic inches of sand per minute to each square inch of cross section of the air tube *b*, *b*. In passing down the tube *b*, *b*, the sand acquires a velocity proportioned to that of the air jet, and strikes upon the sheets of glass *f*, *f*, which are carried across and beneath the tube *b*, *b*, at about one inch distance from its lower end by means of a set of caoutchouc belts *e*, *e*, (one inch wide and three inches apart) which move at the rate of about four inches per minute, so that each part of the glass is exposed to the action of the sand blast for about fifteen or twenty seconds. After striking the glass the air and sand rebound therefrom, and passing into the side boxes *g*, *g*, (Fig. 3), are carried into the large settling chamber *h*, *h*, where they lose their velocity, and the sand settles to the bottom, while the air passing on by the tube *i* (Fig. 2) returns to the centre of the rotary fan where it receives a fresh impulse. To diminish the escape of dust and sand the sides of the boxes *g*, *g*, are provided with flap valves of caoutchouc *v*, *v*, which close with a slight elastic pressure upon the glass passing through. There is a direct opening from the boxes *g*, *g*, between the valves *v*, *v*, down into the chamber *h*, so that the pressure of the blast holds the sheets of glass down upon the belts *e*, *e*. The sand which settles to the bottom of the chamber *h* is raised by the elevator *k* into the sand box *c*, and is repeatedly used until it becomes too fine.

By making the settling chamber *h* of sufficient size and dividing it into compartments the dust or powder of the sand and glass of various degrees of fineness may be collected separately, and may be utilized as a grinding or polishing substance. I have found it convenient in practice to put a valve or stopper at the bottom of the sand tube *d*, *d*, so as to stop the supply of sand at will. To avoid complication this is not shewn in the Drawing, but can readily be arranged by any engineer. When the impelling jet has a pressure greater or less than above mentioned a proportionately shorter or longer time will be required to grind or depolish the surface of the glass. With a blast of the above-mentioned pressure covering patterns or stencils cut out of strong writing paper or made of thread or bobbinet or lace pasted or pressed close to the glass, will last long enough to admit of a complete grinding or depolishing of the uncovered surfaces so as to produce designs or ornaments engraved upon the glass.

When designs or ornaments are to be cut through the colored stratum of flashed glass the covering pattern or stencil must be of a strength and durability proportioned to the thickness to be cut or ground away. Toughness and elasticity, and the absence of brittleness or pulverizability appear to be the qualities needed in the covering substance to resist the cutting action of sand. Caoutchouc, particularly when vulcanized, possesses the desired properties in an eminent degree and may be taken as a type. Parchment and parchment paper possess considerable durability. By soaking or covering paper or threads with a tough or elastic dressing or varnish their durability as patterns or stencils may be increased. I have used for this purpose the elastic compound of glue and glycerine employed for printers' rollers. I have sometimes used as a covering substance whitelead paint, and sometimes a paint made of a watery solution of dextrine or British gum mixed with about one-third of its weight of glycerine and thickened with litharge. The pattern may be drawn with the paint thickly applied by the brush, or by stencils, or by block printing, or the glass may be covered all over, and when dry the design cut through the protecting coat. A layer of wax will resist a blast of the pressure of one inch of water impelling sand which has passed through a sieve of fifty wires per inch. Known photographic processes produce on smooth surfaces a film of bichromatized gelatine, which covers some parts of the surface and leaves other parts exposed. I have found this film to be capable of resisting the action of a blast of

fine sand such as that last mentioned during a sufficient time to produce a grinding or cutting of the exposed surfaces, and I have thus engraved photographic pictures. The finer the sand used, and the less the pressure of the blast, the finer is the grain of the depolished surface and the weaker and more delicate may be the texture of the covering substances used to produce the design.

Numerous processes are known and used in the arts for producing, printing, or transferring designs on to surfaces, any of these processes by which a design can be produced or transferred in a sufficiently tough and resistant medium may be used to prepare a surface for being engraved by the sand blast. Many natural objects such as plants, leaves, &c., which can be fastened flat upon a surface have sufficient strength and resistance to a blast of fine sand to admit of their outline being thus engraved. Designs engraved by the sand blast to a sufficient depth either in relief or in intaglio on a smooth surface, slate or glass, for example, can be reproduced by known processes of printing. When wood is subjected to a sand blast of moderate velocity the softer and more brittle portions are more rapidly and deeply cut away than others, and the grain or texture of the wood and the hard lines and knots are thus brought out in relief. When the sand blast at moderate velocities is directed upon a metallic surface it removes but little of the metal, but the grains of sand make innumerable small indentations of the surface and produce a frosted, dull, matted, or dead appearance. By using suitable stencil plates or covering substances, designs, or devices can thus be engraved on metallic surfaces.

If desired the sand may be propelled by a current of air produced by suction or a partial vacuum made in any convenient manner, as by a fan, or steam jet, or any other known machine, or the sand may be impelled by a mixed current of steam and air produced by a steam jet in the ordinary manner.

I have described above several arrangements for projecting the sand with the requisite velocity by means of jets of steam or air, but I do not mean to confine myself thereto. Any method or arrangement of jets or currents of steam, air, water, or other suitable gas or liquid may be used by which sufficient velocity can be artificially given to the sand to enable it to cut or grind the object.

**Having now set forth the nature of the Invention of "** Improvements

in Cutting, Boring, Grinding, and Pulverizing Stone, and other Hard Substances," as communicated to me from abroad, and having explained the manner of carrying the same into effect, I wish it to be understood that what I claim under the above in part recited Letters Patent is, the employment for the above-named purposes of sand used as a projectile to which the requisite velocity has been artificially given by a jet or current of steam, air, water, or other suitable gas or liquid.

In witness whereof, I, the said Alfred Vincent Newton, have hereunto set my hand and seal, the Thirty-first day of January, in the year of our Lord One thousand eight hundred and seventy-one.

A. V. NEWTON. (L.S.)

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Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty. 1875.

D. 1870. Aug. 1. № 2147.
NEWTON'S SPECIFICATION.
(2nd Edition)

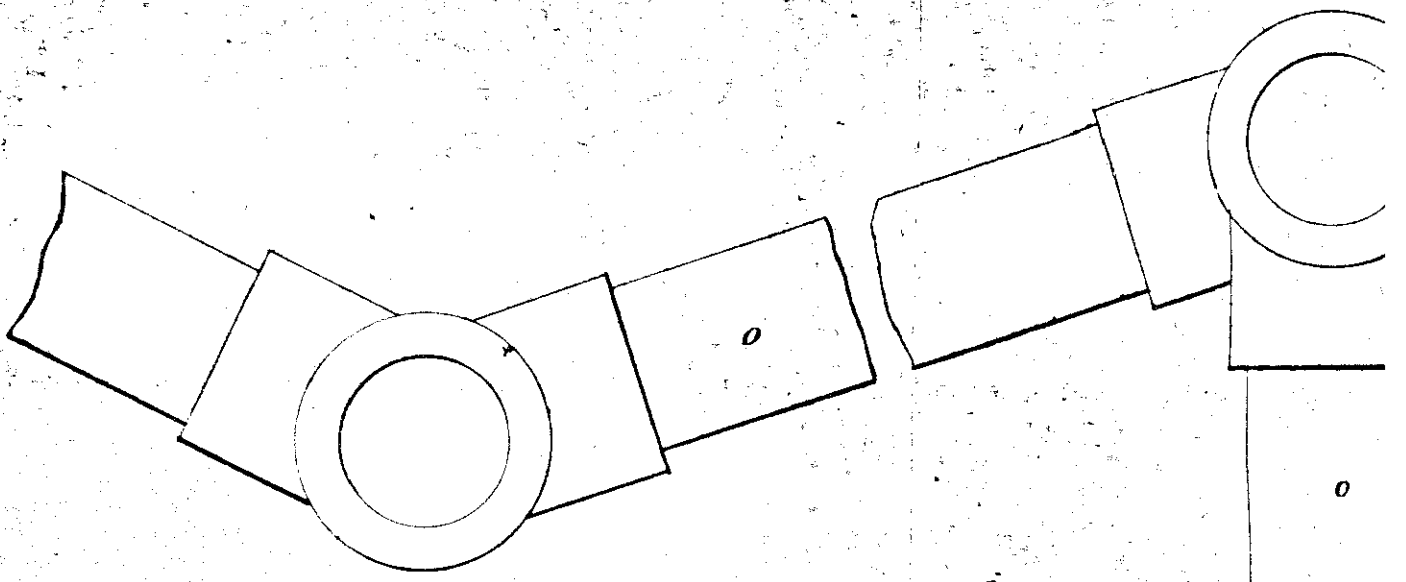
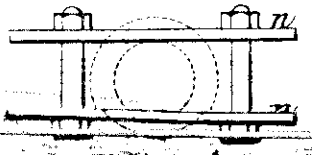



FIG. 1.

FIG. 1a



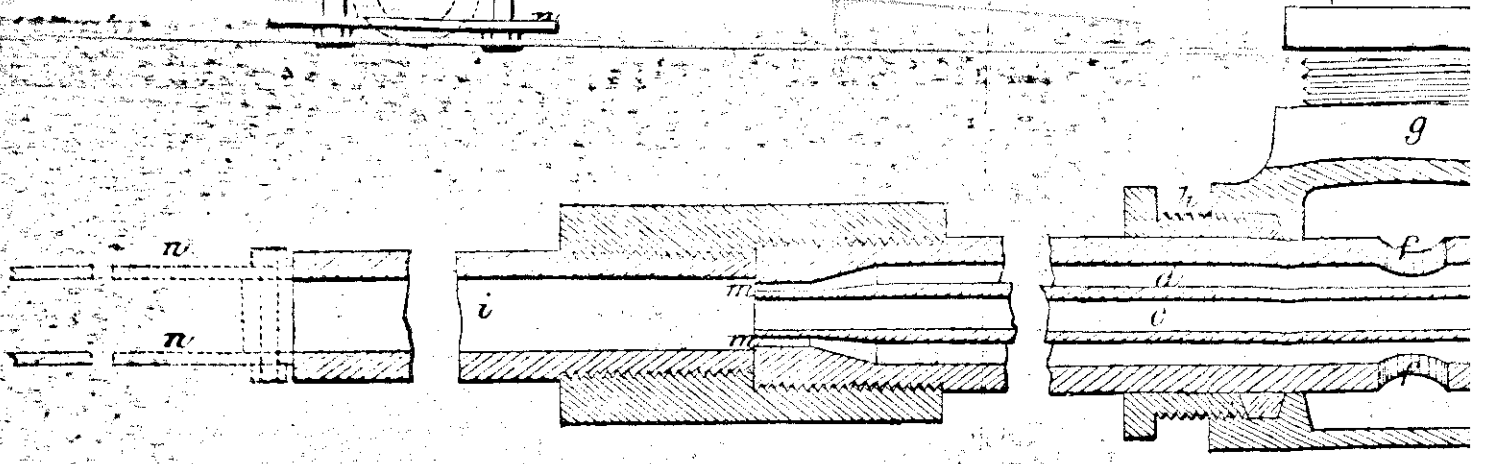
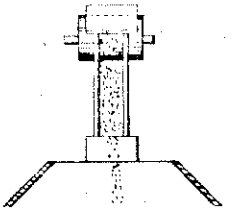




FIG. 2.



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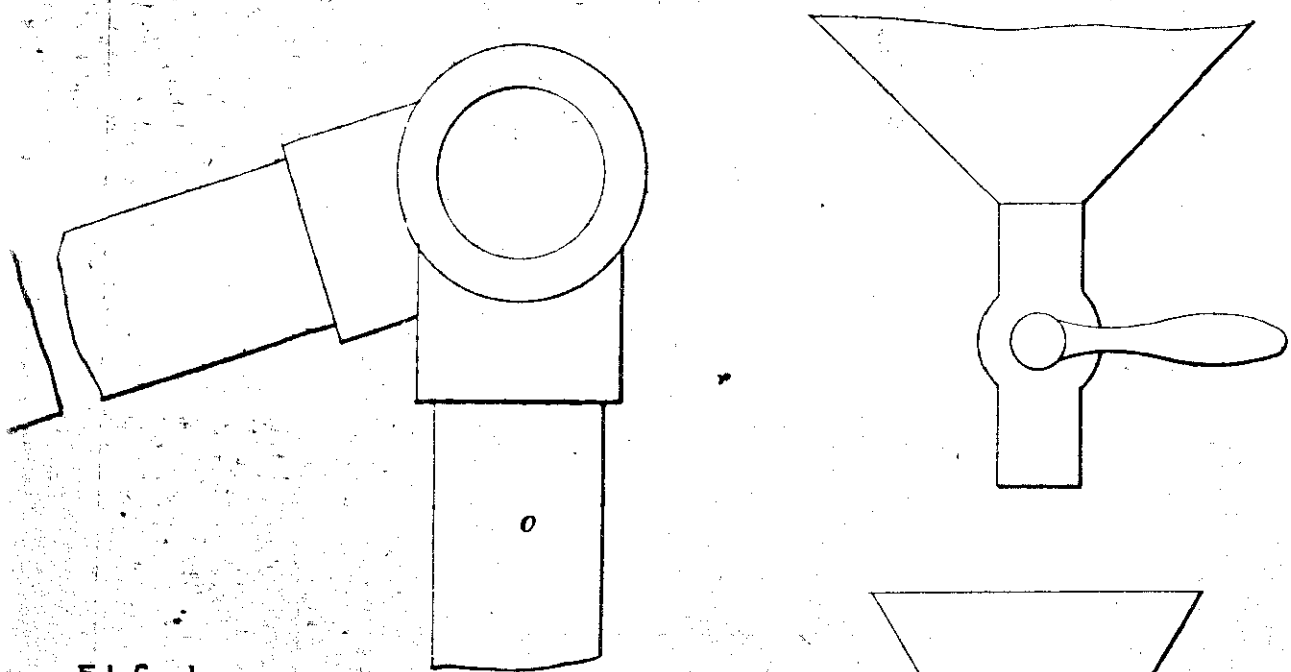



FIG. 1.

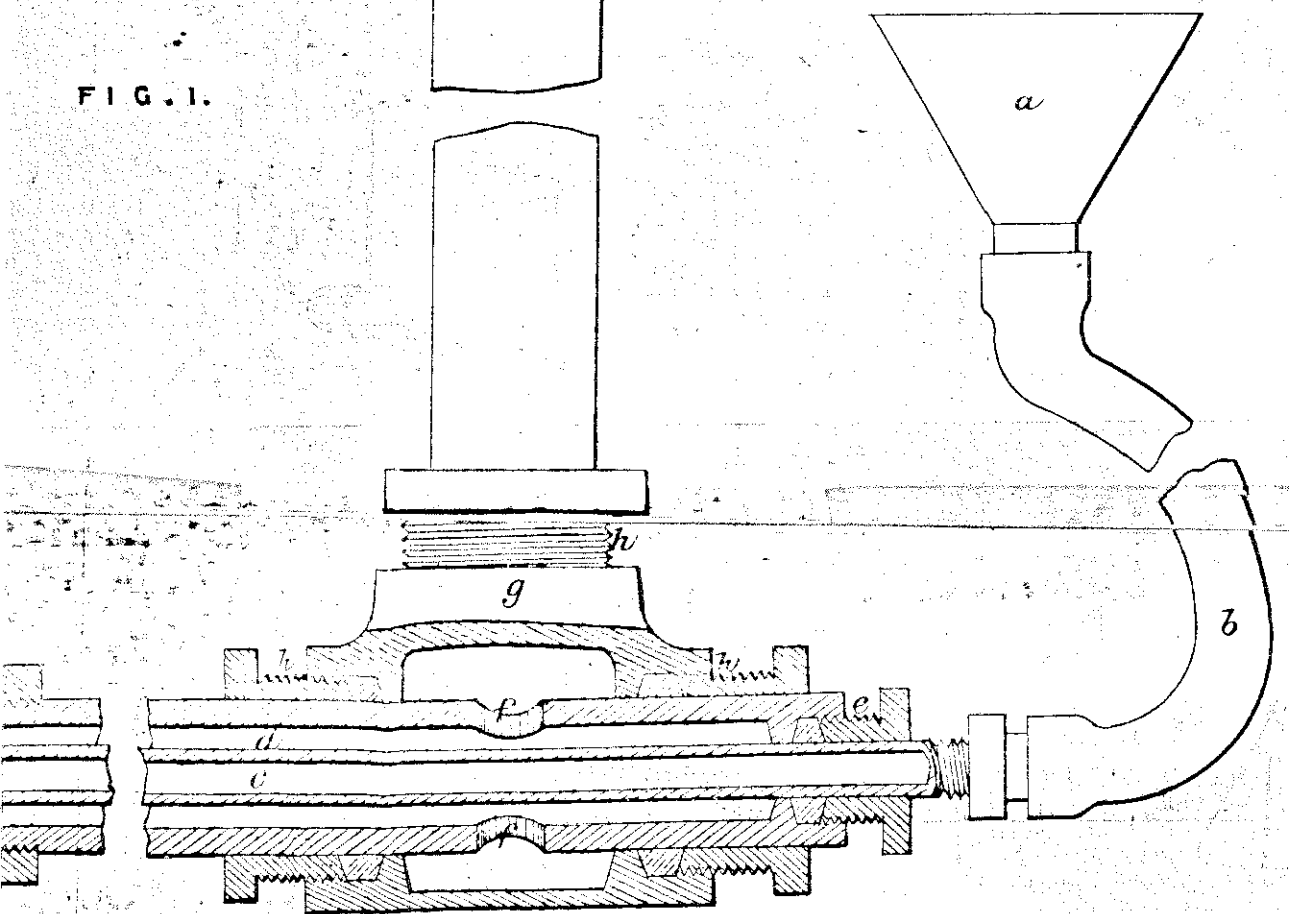



FIG. 3.

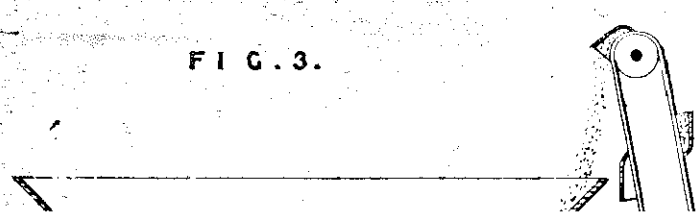
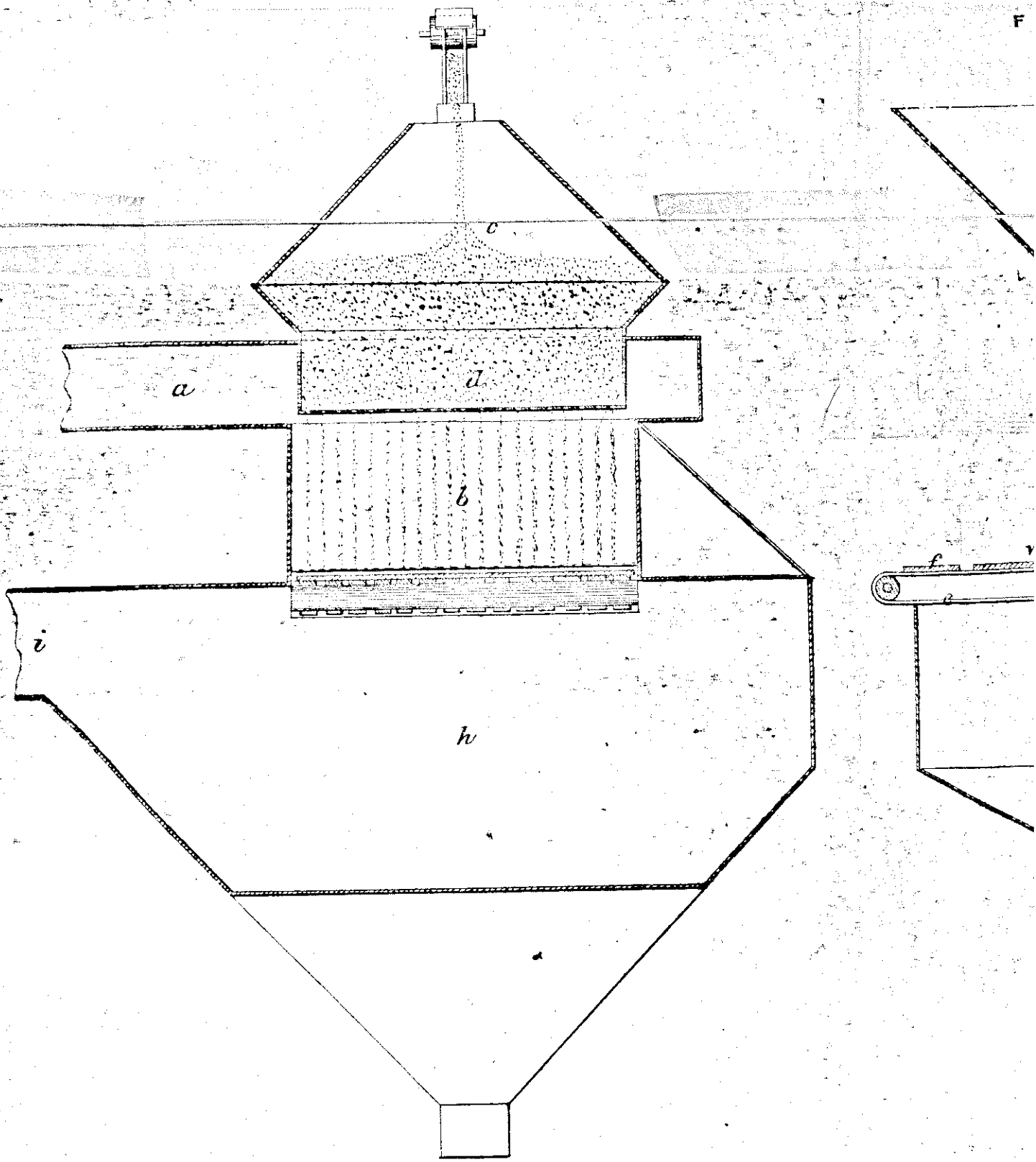


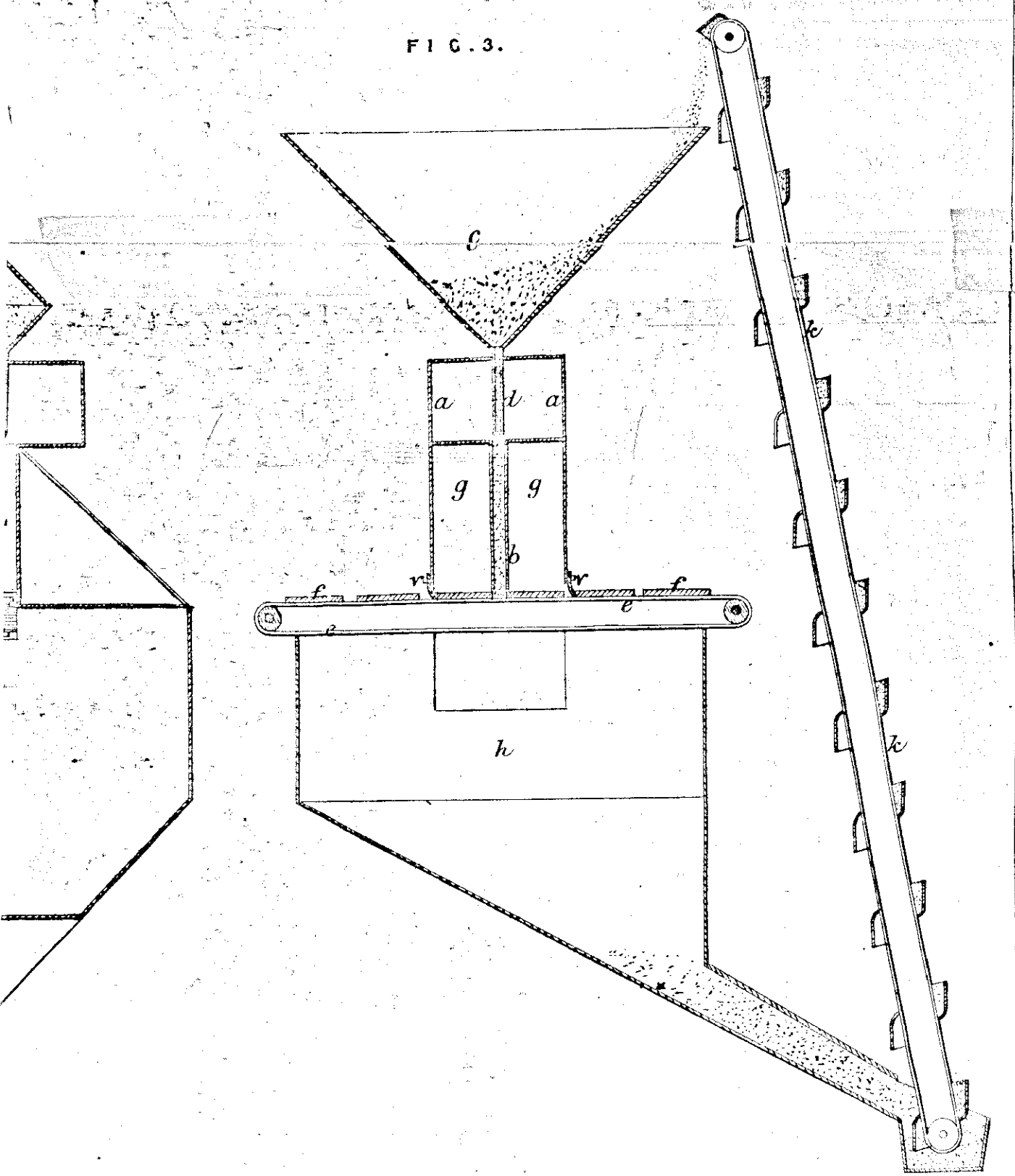
FIG. 2.




*The filed drawing is partly colored.*

LONDON Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISW
Printers to the Queen's most Excellent Majesty 1875

FIG. 3.




Drawn on Stone by Malby & Sons.

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