(No Model.) 3 Sheets—Sheet 1.

# F. W. WETHERBEE.

## APPARATUS FOR ENAMELING DIALS.

No. 452,150. Patented May 12, 1891.

Fig. 1.

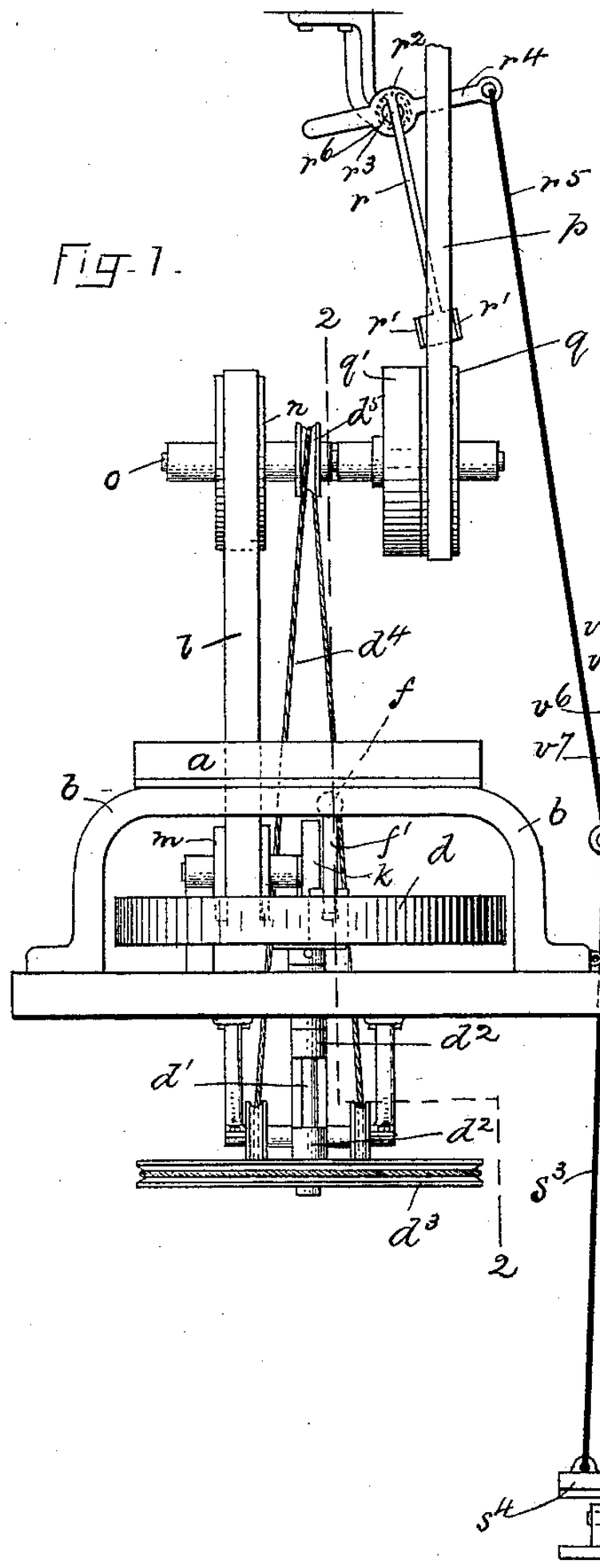
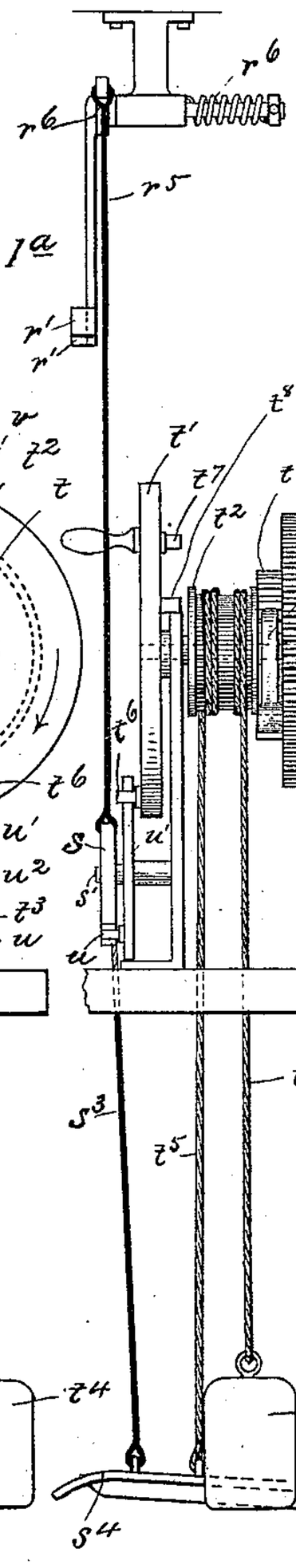



Fig. 1a.




WITNESSES:

Edwin W. Hamlen

C. G. Bartlett

INVENTOR:

F. W. Wetherbee

by Wright Brown Quinby & Otis

Attys

(No Model.) 3 Sheets—Sheet 2.

# F. W. WETHERBEE.

## APPARATUS FOR ENAMELING DIALS.

No. 452,150. Patented May 12, 1891.

Fig. 3.

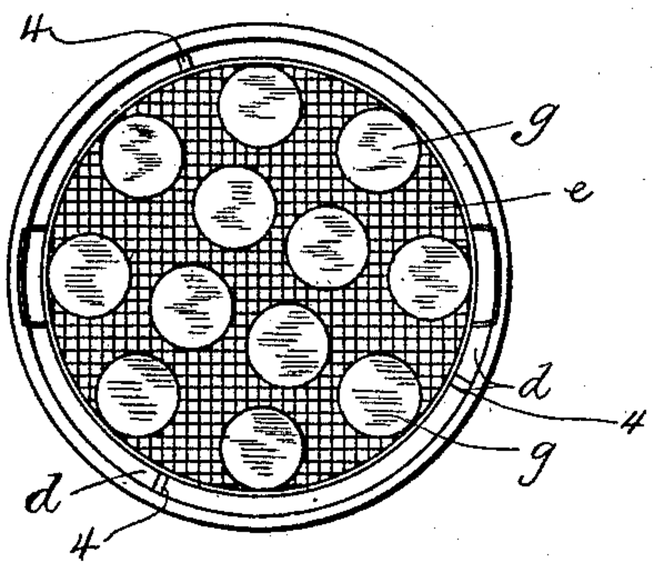



Fig. 2.

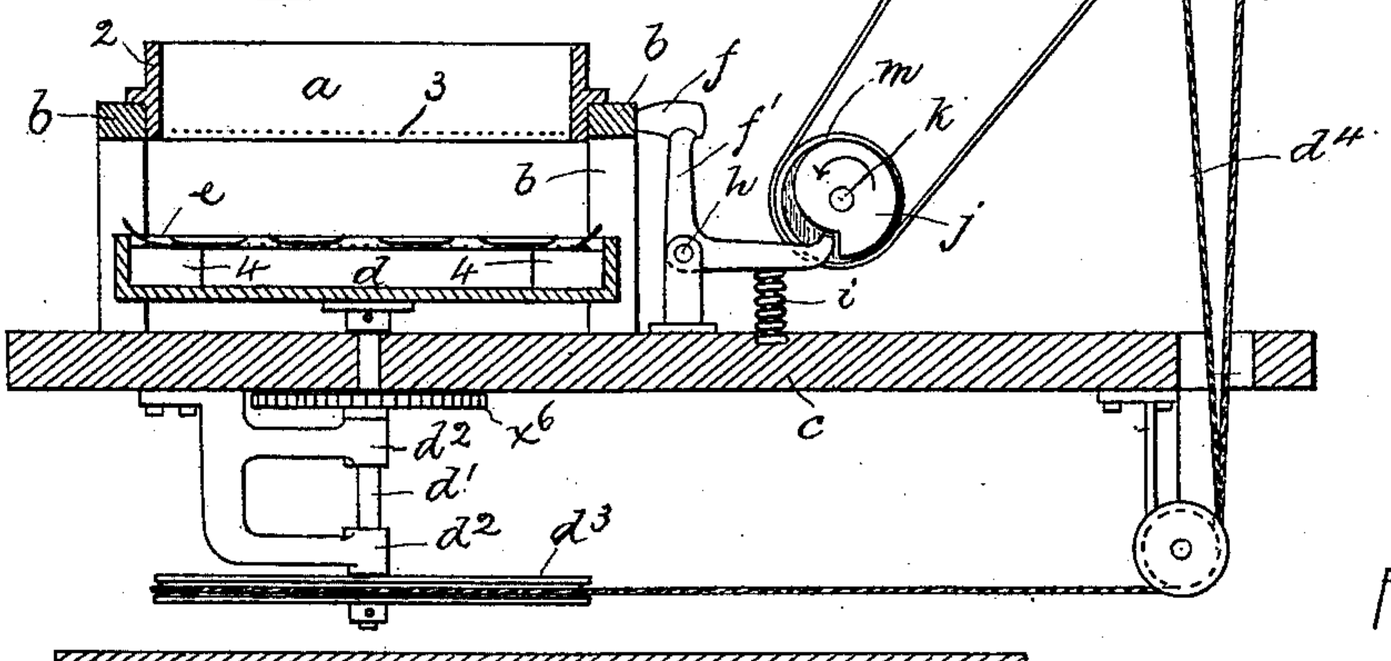



Fig. 5.

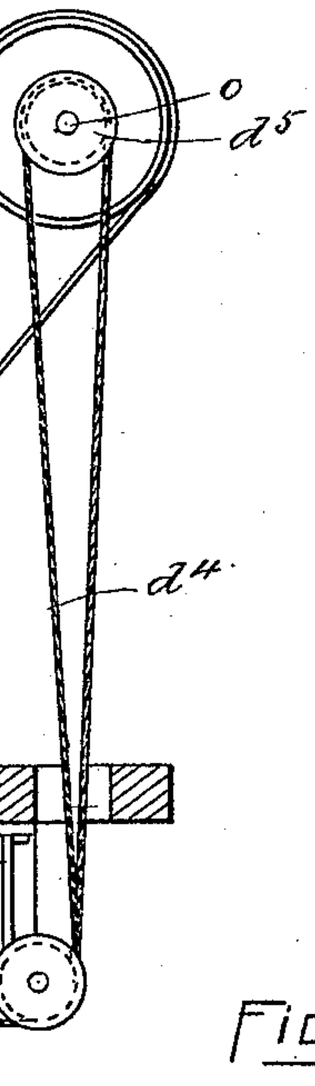
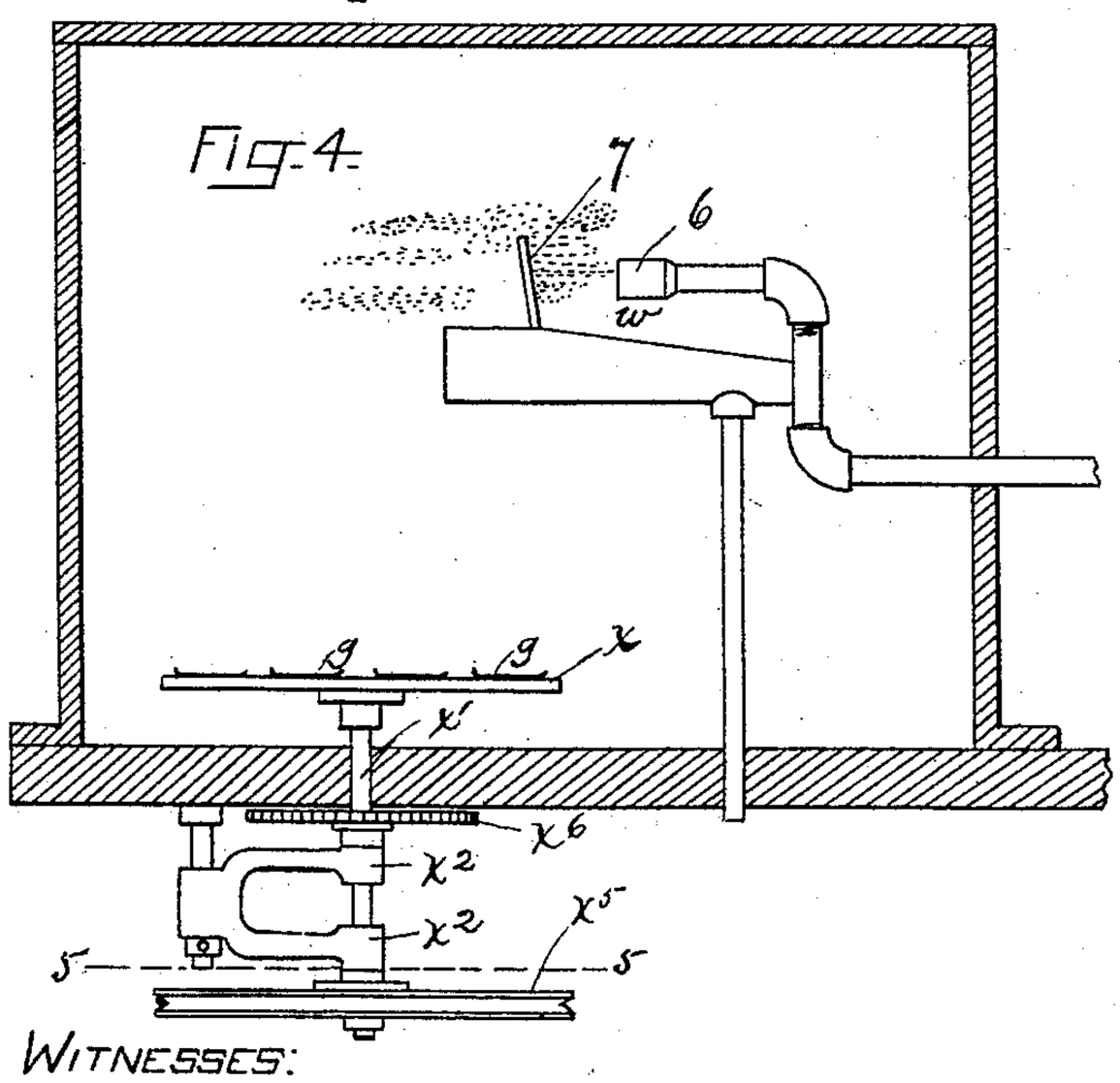
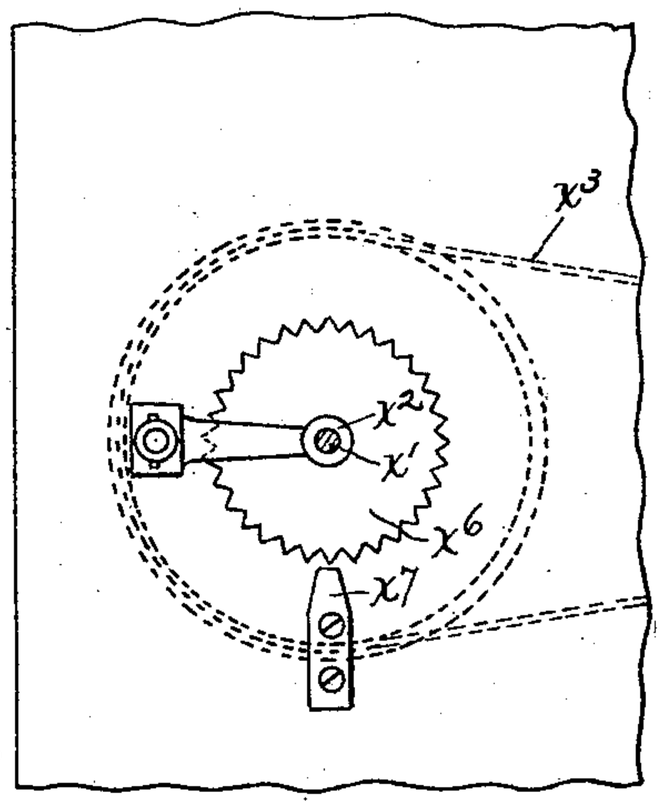



Fig. 4.




WITNESSES:
Irving W. Hamlen.
C. G. Bartlett.

INVENTOR:
F. W. Wetherbee
by Wright Brown Quinby & Otts.

(No Model.) 3 Sheets—Sheet 3.

# F. W. WETHERBEE.

## APPARATUS FOR ENAMELING DIALS.

No. 452,150. Patented May 12, 1891.

Fig. 6.

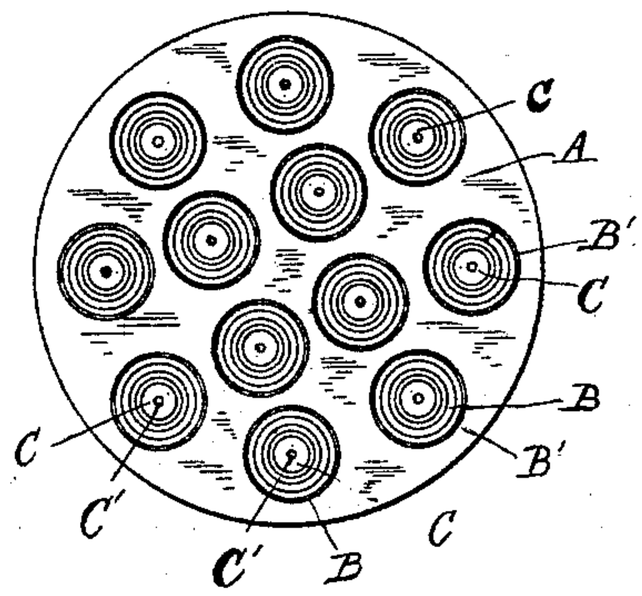



Fig. 10.

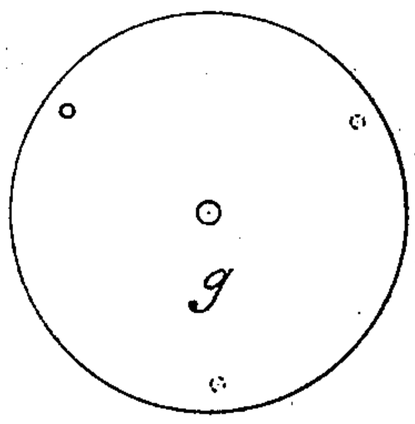



Fig. 7.

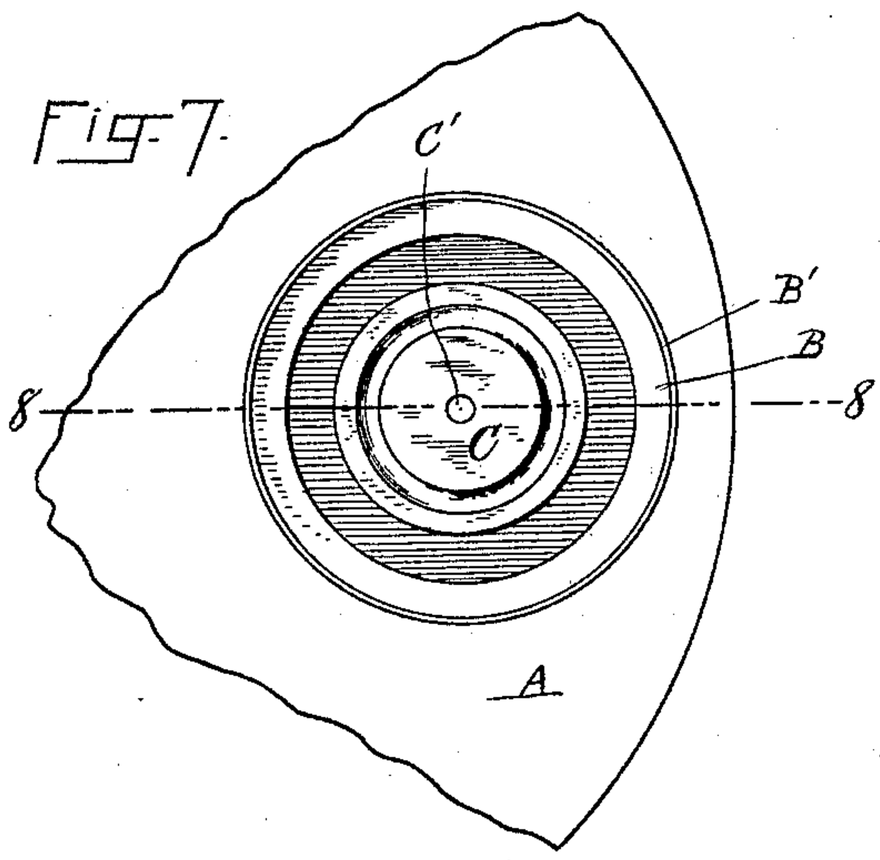



Fig. 8.

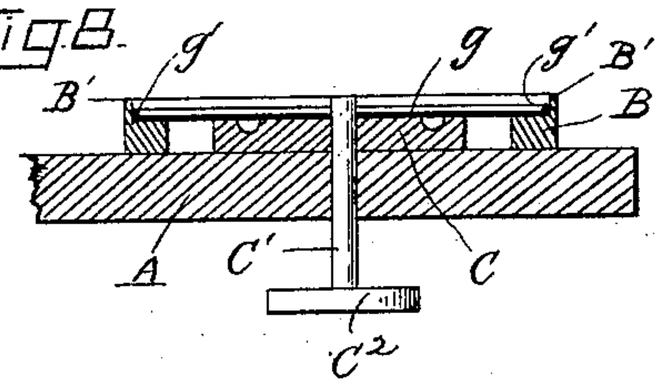



Fig. 9.

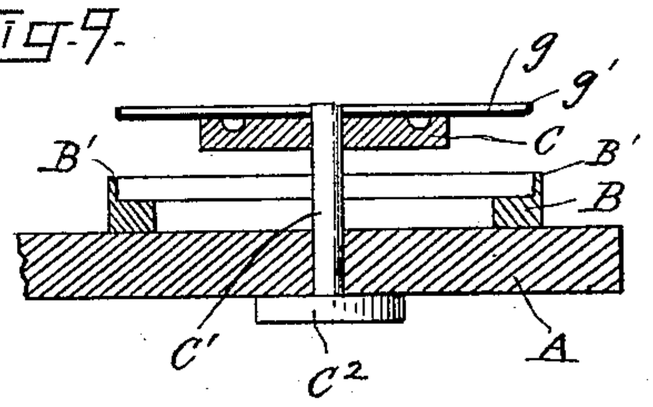
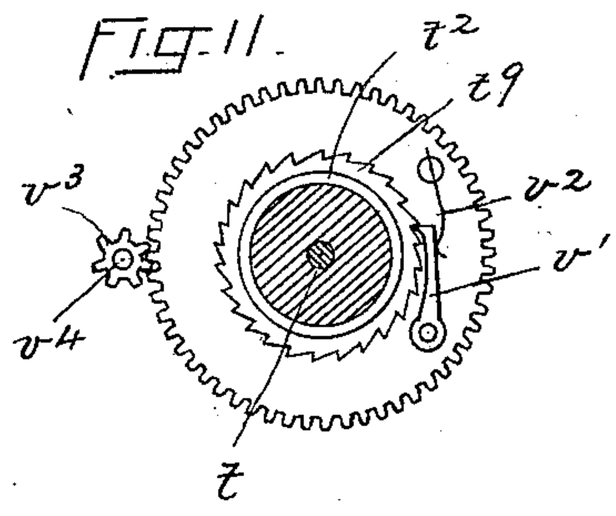



Fig. 11.




WITNESSES:
Louis W. Stanley.
C. G. Bartlett

INVENTOR:
F. W. Wetherbee
by Wright Brown Quinby & Otis
Attys

# UNITED STATES PATENT OFFICE.

FRANK W. WETHERBEE, OF WALTHAM, MASSACHUSETTS, ASSIGNOR TO THE AMERICAN WALTHAM WATCH COMPANY, OF MASSACHUSETTS.

## APPARATUS FOR ENAMELING DIALS.

SPECIFICATION forming part of Letters Patent No. 452,150, dated May 12, 1891.

Application filed December 15, 1890. Serial No. 374,740. (No model.)

*To all whom it may concern:*

Be it known that I, FRANK W. WETHERBEE, of Waltham, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Enameling Dials for Watches and other Time-Pieces, of which the following is a specification.

My invention pertains to that department of dial-making which has to do with the deposition of the pulverized enamel on the surface or surfaces of the metallic disk or blank which constitutes the basis or foundation of the dial. The ordinary method of performing this work has been to have a bowl or other suitable dish containing the pulverized enamel saturated with water. The workman, holding in one hand a single dial-blank, with a spatula takes from the dish a quantity of the wet enamel sufficient in his judgment to cover the blank to the desired thickness. This he distributes as evenly as may be over the surface of the blank, and then by the application of a towel or other suitable pad removes by absorption as much as possible of the water. The enamel is then smoothed over with the face of the spatula and then laid aside to dry, and when sufficiently dried it is taken to the furnace and fused. A serious objection to this method is the difficulty of obtaining uniformity in the amount of enamel spread upon the different blanks and also even distribution over the entire surface. An improvement on this method consists in placing a number of the blanks in a receptacle containing the pulverized enamel in a large quantity of water, which by violent agitation is made to lift and hold the enamel in suspension, and then allowing it to deposit itself on the blanks by gravity. This process is not free from the objections which have been mentioned—that is, the uncertainty as to the amount of enamel which may be deposited on the blanks and the impossibility of maintaining constant conditions in the operation.

My invention has for its object to obviate the difficulties incidental to the methods of applying enamel to dial-blanks and to enable enamel to be applied uniformly, accurately, and quickly to said blanks.

The invention consists in the improvements hereinafter described, whereby enamel may be applied by the following steps, viz: first, holding a number of dial-blanks with their backs upward in a horizontal position under a sieve containing a supply of powdered enamel, agitating the sieve by giving it a predetermined number of blows to cause a predetermined quantity of enamel to fall upon the upper surfaces of the blanks, then moistening the coating of enamel thus deposited upon the blanks to cause said coating to adhere to the blanks with sufficient tenacity to permit the blanks to be inverted without losing the said coatings, then inverting the blanks so that their uncoated sides will be uppermost, and holding the blanks again under the sieve and applying or depositing a coating of powdered enamel, as before, the blanks being thus provided with two coatings, the one upon the under side, which is the back of the dial, being in a moist condition and adhering thereto, while the coating upon the upper side is supported by the dial and does not require to be moistened, so that the dial may be placed in a furnace and subjected to heat to fuse the two coatings and attach them permanently to the blank.

In the accompanying drawings, forming a part of this specification, Figure 1 represents a front elevation of the sieve and a tray or support to hold a series of dial-blanks in a horizontal position under the sieve, said figure also showing a sieve knocking or agitating device, and a timing mechanism to determine the extent of the operation of said knocking device upon the sieve and the depth of the coating deposited by the agitation of the sieve upon the dial-blanks. Fig. 1ª represents an end view of the timing mechanism shown in Fig. 1. Fig. 2 represents a vertical section on line 2 2, Fig. 1. Fig. 3 represents a top view of the tray or holder which supports the dial-blanks under the sieve. Fig. 4 represents a vertical section of the apparatus employed for moistening the enamel coating first applied to the dial-blanks to

cause the adhesion of said coatings to the blanks. Fig. 5 represents a section on line 5 5, Fig. 4, looking upwardly. Fig. 6 represents a top view of the tray or holder which is used to support the dials during the operation of applying the second or dry coating of enamel. Fig. 7 represents an enlarged top view of a portion of the tray shown in Fig. 6. Fig. 8 represents a section on line 8 8, Fig. 7, showing also a dial-blank in position on the tray to receive a coating of enamel. Fig. 9 represents a similar section showing the dial-blank lifted from the tray by an automatic device with which the tray is provided. Fig. 10 represents a top view of a dial-blank.

The same letters and numerals of reference indicate the same parts in all the figures.

In the drawings, *a* represents the sieve, which consists of a light frame 2, preferably of wood, mounted upon supports *b b*, which rest upon the bench or fixed table *c*, and a diaphragm 3, of suitably fine reticulated material, such as bolting-cloth, attached to said frame. The sieve is raised by the supports *b b* sufficiently high above the table to accommodate under the sieve a holder *d*, adapted to support a series of dial-blanks in a horizontal position. The blanks are preferably placed upon a removable rack or tray *e*, which is placed upon supports 4 4, attached to the holder *d*.

*f* represents a hammer, which is attached to a bell-crank lever *f'*, and is arranged to strike the sieve-frame 2 or one of the supports *b* thereof, and by so doing sufficiently agitate the sieve to cause a quantity of powdered enamel placed therein to pass through the meshes of the sieve and fall upon the dial-blanks *g* on the holder below the sieve. The hammer-lever *f'* is pivoted at *h* to an ear or support on the fixed table *c*. One arm of said lever projects backwardly and is pressed upwardly by a spring *i* against a cam *j*, which is affixed to a horizontal shaft *k*, mounted in bearings on the table *c*. Said shaft is rotated by power applied to it through a belt *l*, running upon a pulley *m* on the shaft, said belt being driven by a pulley *n* on a shaft *o*, which is belted to a driving-shaft. (Not shown.) The rotation of the shaft *k* causes the cam *j* to alternately depress and release the arm of the hammer-lever *f'*, which bears against it, so that said cam and the spring *i* together oscillate the hammer and cause it to strike the sieve.

It will be seen that the quantity of enamel passing through the sieve is dependent upon the number of blows given by the hammer *f*. To regulate the quantity of enamel passing through the sieve and the thickness of the coating deposited upon the blanks *g*, I provide automatic timing mechanism which determines the number of blows given by the hammer and stops the operation of the hammer after the requisite number have been given. I am at present using with good results a timing mechanism which stops the rotation of the cam *j* after a predetermined number of rotations by shifting the belt *p*, that drives the shaft *o*, from a fast pulley *q'*, affixed to said shaft, to a loose pulley *q* beside the pulley *q'*. Said mechanism is organized as follows: *r* represents a belt-shipper, which is an arm having at one end fingers *r' r'* engaged with the belt *p* and attached at its other end to a plate $r^2$, which is pivoted at $r^3$ to a fixed support and has an arm $r^4$. Said arm $r^4$ is connected by a rod $r^5$ with a lever or latch *s*, which is pivoted at *s'* to a fixed support, and is provided at one end with a shoulder $s^2$. Said latch *s* is connected by a rod $s^3$ with a treadle $s^4$ below the table *c*. *t* represents a shaft, which is journaled in a supporting-frame affixed to the table *c* and has a disk *t'* affixed to one of its ends. $t^2$ represents a drum affixed to the shaft *t*. To the drum $t^2$ is affixed a cord $t^3$, to which is attached a weight $t^4$, adapted to rotate the drum $t^2$ and shaft *t* in the direction indicated by the arrow in Fig. 1. $t^5$ represents a cord, which connects the treadle $s^4$ with the drum $t^2$, said cord $t^5$ being arranged so that the depression of the treadle $s^4$ will rotate the drum through said cord in the direction required to wind a portion of the cord $t^3$ upon the drum, and thus raise the weight $t^4$. The depression of the treadle $s^4$ also causes the rod $s^3$ to depress the end of the latch *s*, to which it is attached, thus causing the shoulder $s^2$ at the other end of said latch to be engaged and locked by a pin *u* on a lever *u'*, which is pivoted at $u^2$ to a fixed support. The last-described movement of the latch *s* causes the rod $r^5$ to move the shipper-supporting plate $r^2$ and the shipper *r* thereto attached in the direction required to shift the belt *p* from the loose pulley *q* to the fixed pulley *q'*, thus setting the shaft *o* in motion and causing said shaft to impart motion to the cam *j*. The disk *t'*, attached to the shaft *t*, has an adjustable stud or pin $t^6$ projecting from one of its sides and an adjustable pin $t^7$ projecting from its opposite side. The object of the pin $t^7$ is to limit the rotation of the shaft caused by the depression of the treadle $s^4$ by striking a fixed stop $t^8$. The object of the pin $t^6$ is to strike the lever *u'* when the disk *t'* and shaft *t* are rotating in the direction indicated by the arrow in Fig. 1, and thus move said lever in the direction required to throw the stud *u* thereon out of engagement with the latch-shoulder $s^2$, thus releasing the latch *s* and permitting a spring $r^6$, affixed to the shipper-supporting plate $r^2$, to turn said plate and the shipper-arm in the direction required to shift the belt from the fast pulley *q'* to the loose pulley *q*. $t^9$ represents a ratchet-wheel affixed to the shaft *t* at one end of the drum $t^2$. *v* represents a gear-wheel mounted loosely on the shaft *t* and provided with a pawl *v'*, which is pressed by a spring $v^2$ against the ratchet

$t^9$. Said gear $v$ meshes with a pinion $v^3$ on a shaft $v^4$, which shaft is provided with an escape-wheel $v^5$. Said escape-wheel co-operates with an anchor-escapement $v^6$, of the usual or any suitable construction, having a pendulum $v^7$. The object of said escapement devices and the pinion $v^3$ and gear $v$ is to control the rotation of the shaft $t$ by the weight $t^4$, said devices constituting an ordinary escapement mechanism, which is too well known to require detailed description.

The operation of the described timing mechanism is as follows: The driving-belt $p$ is normally held upon the loose pulley by the action of the spring $r^6$, connected with the shipper-supporting plate $r^2$. When the operator desires to set the hammer in motion, he depresses the treadle $s^4$, thus raising the weight $t^4$ as far as the pin $t^7$ and stop $t^8$ will permit, and also swinging the shipper-supporting plate $r^2$ and the shipper thereon to the position required to engage the belt $p$ with the fast pulley, the belt being held in this position by the interlocking of the latch $s$ with the stud $u$ on the lever $u'$, said stud being held normally in position to engage the shoulder $s^2$ on the latch by means of a spring $u^3$. The cam $j$ is continuously rotated during the engagement of the belt $p$ with the fast pulley, said engagement continuing until the pin $t^6$, which was moved away from the lever $u'$ by the rotation of the shaft $t$, caused by the depression of the treadle $s^4$, is carried by the rotation of said shaft, caused by the descent of the weight, against the upper end of the lever $u'$, as shown in Fig. 1, said pin on striking the lever causing the stud $u$ to move out of engagement with the shoulder $s^2$ of the latch $s$, the latch being thus released and caused to release the shipper-carrying plate $r^2$, so that the spring $r^6$ throws the shipper back to position to move the belt $p$ to the loose pulley, thus stopping the rotation of the hammer-operating cam $j$. It will be seen that the extent of the rotation of the cam $j$ is dependent upon the adjustment of the pin $t^7$, said pin being adjustably secured in an annular groove formed in one side of the disk $t'$, so that the pin $t^7$ can be adjusted relatively to the fixed stop $t^8$, so as to permit any desired movement of the shaft $t$ by the depression of the treadle, and therefore any desired separation of the pin $t^6$ from the point at which it displaces the lever $u'$. Hence the timing mechanism can be adjusted to permit any desired number of blows of the hammer upon the sieve, and to then automatically stop the motion of the hammer.

My invention is not limited to this particular form of timing mechanism, as any other mechanism adapted to produce a like result may be adopted without departing from the spirit of my invention. The holder $d$ is preferably slowly rotated while the coating is being deposited upon it, and to this end said holder is mounted upon a shaft $d'$, journaled in bearings $d^2$ $d^2$, and provided with a pulley $d^3$, which is connected by a belt $d^4$ with a small pulley $d^5$ on the shaft $o$. In practice the backs of the dial-blanks are first coated by the operation above described, and as it is necessary to invert the blank before depositing the coating over the front of the dial I cause the back-coating to adhere to the dial-blank by moistening said coating. To this end I place the dial-blanks after their backs have been coated in the manner above described in suitable proximity to an atomizer or spraying device, which is constructed to convert a jet of water into fine particles or atoms set free in the presence of the coatings on the dial-blanks and uniformly moisten said coatings, thus causing them to adhere to the blanks with sufficient firmness to permit the blanks to be inverted for the purpose of receiving another coating of dry powdered enamel. The atomizer $w$, which I prefer to employ, is shown in Fig. 4, and comprises a nozzle 6, adapted to deliver minute streams of water upon a deflector 7, the said deflector breaking up said streams into a mist or fog, which acts upon the coatings of dry powdered enamel on the blanks and speedily reduces them to the form of paste. I prefer to locate the atomizer $w$ above the coated blanks, the latter being placed upon a horizontal table. Said table may be the fixed bench or table $c$; but I prefer to employ a rotary table $x$ above the table $c$, said table $x$ being mounted upon the shaft $x'$, which is journaled in bearings $x^2$ $x^2$, and is given a slow rotary movement by means of a belt $x^3$, running from a small pulley on the shaft $o$ to a larger pulley $x^5$ on the shaft $x'$. The rotary motion thus imparted to the table $x$ causes the coated dial-blanks to revolve in the presence of the atoms of water, and tends to produce a more uniform action of the water upon the enamel in case the distribution of atoms of water is not absolutely uniform, or, in other words, in case the atoms or particles of water are closer together at some points than at others. I prefer to give the table $x$ a slight lateral agitation or shaking movement to form smooth surfaces on the moistened coatings, and to this end I provide the shaft $x'$ with a wheel $x^6$, having small V-shaped teeth cut on its periphery. The bearings $x^2$, in which the shaft $x'$ is journaled, are adapted to swing sufficiently to bring the periphery of the wheel $x^6$ into contact with a fixed finger $x^7$ on the under side of the table $c$, the contact of the said wheel with the finger $x^7$ causing the wheel, the shaft, and the dial-supporting table $x$ to vibrate rapidly in a minute arc, the dials being thus given a shaking motion, which has a tendency to smooth the upper surfaces of the enamel coatings after they have been sufficiently moistened. The belt $x^3$, which rotates the shaft $x'$, is arranged so that its tension normally acts to pull the wheel $x$ away from the finger $x^7$, as shown in Fig. 5. Hence the shaking movement above described is not imparted to the shaft

and the dial-supporting table unless the operator moves the swinging bearings $x^2$ sufficiently to bring the wheel $x$ into contact with the finger $x^1$. The object of this arrangement is to prevent the shaking of the dials when they are first placed in the neighborhood of the atomizer and before they have been sufficiently moistened to adhere to the dial-blanks. After the enamel coatings have been moistened and caused to adhere to the blanks the blanks are inverted, and after the surplus moisture has been absorbed from the enamel coatings by placing the same upon an absorbent surface, such as cotton cloth, the dials, with their uncoated sides upward, are placed upon a tray A, constructed as shown in Figs. 6, 7, 8, and 9, and placed beneath the sieve as before and caused to receive a coating of powdered enamel by the percussive action of the hammer upon the sieve in the manner above described. The tray A has a series of annular seats B, each having an upwardly-projecting rim B′ at its margin of sufficient diameter to inclose the margin of the dial-blank and of sufficient height to project above said margin and form a wall around the same, as shown in Fig. 8, the object of said wall being to retain the powdered enamel at the margin of the dial when the coating has attained a thickness greater than the depth of the upturned flange $g'$, formed on the margin of the dial-blank $g$.

Within each annular seat B is a vertically-movable button or plate C, to which is attached a vertical stem C′, passing loosely through an orifice in the tray A and having at its lower end a foot or enlargement $C^2$. The object of the plate C is to automatically raise the dials from the seats B after they have been coated, this result being accomplished by placing the tray A upon a suitable table or flat support, the contact of the heads $C^2$ with said support causing the plates C to rise with the dials, as indicated in Fig. 9. When the dials are being coated, the heads $C^2$ and the plates C are allowed to remain in the position shown in Fig. 9, the tray A being supported by the arms or supports 4 in the dial-holder located under the sieve during the operation of dusting on the coating of enamel, so that there is nothing to raise the plates C while the tray A is on the holder $d$. When, however, the tray is removed from the holder and placed upon the bench or table, the dials are all raised from their seats B by the contact of the heads $C^2$ with said bench or table. Hence the dials, with their coatings, may be readily removed from the tray A. It is not necessary to moisten the last coating applied, because the dials can be readily transferred to the firing-furnace without disturbing the upper coating. In practice the dials are removed to the firing-furnace immediately after the upper coatings have been applied, the firing operation being conducted in the usual manner until the coatings have been fused and caused to adhere firmly to the dial-blanks.

It will be seen that by the described method and apparatus the enamel coatings can be applied uniformly to any desired number of dials, each dial receiving a coating of exactly the same thickness as all the others. Hence all the uncertainty and the various disadvantages attending the methods of coating dial-blanks heretofore practiced are obviated by my improvements.

In enameling watch-dials different kinds of enamel are employed for different classes of dials, some being coated with what is known as "glass" or "soft enamel," while others are coated with what is known as "hard enamel." The operation of applying the enamel is the same in both cases; but when the soft enamel is used the surfaces of the dial-blank have to receive a preliminary coating of a special enamel, which, when fused, will adhere to the metallic surfaces of the blank and to which the glass enamel will adhere when fused, it being a fact that the soft enamel will not adhere to the metallic surfaces of the blank. The said preliminary coatings are applied to the blank in the manner above described—viz., by dusting on—the coating first applied being moistened to cause it to adhere to the blank. After said preliminary coatings have been fused the final coatings are applied in the manner described.

I claim—

1. As a means of depositing a powdered-enamel coating of predetermined thickness on a dial-blank, the combination of a sieve, a hammer or knocking device arranged to give said sieve a series of blows, and a timing mechanism whereby the number of blows is automatically determined, as set forth.

2. The combination of a sieve, a hammer arranged to knock or agitate the sieve, means for operating the hammer, a timing mechanism to determine the number of blows given by the hammer, and a rotating tray or blank-holder under the sieve, as set forth.

3. An organized apparatus for applying coatings of enamel to dial-blanks, the same consisting of a sieve, a knocking device cooperating therewith, a timing mechanism to determine the number of blows given the sieve, and a spraying or moistening device adapted to moisten a coating of powdered enamel on a dial-blank and thereby cause its adhesion to the blank, as set forth.

4. In an apparatus for coating dial-blanks with powdered enamel, the combination of a rotary horizontal table adapted to support dial-blanks, a spraying device or atomizer arranged above said table, and means for rotating said table to cause the blanks to revolve in the presence of the particles of liquid set free by the action of the atomizer, as set forth.

5. In an apparatus for coating dial-blanks with powdered enamel, the combination of a rotary horizontal table adapted to support dial-blanks, a spraying device or atomizer arranged above said table, and means for ro-

tating said table to cause the blanks to revolve in the presence of the particles of liquid set free by the action of the atomizer, and a device for agitating or laterally shaking said table to form a smooth surface on the moistened enamel coating, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 8th day of December, A. D. 1890.

FRANK W. WETHERBEE.

Witnesses:

GEO. E. TOLMAN,

THOMAS COX.