Please read and send in as full a discussion as possible at earliest date.

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THE MECHANICAL EQUIPMENT OF THE OTTAWA MINT.

By A. H. W. Cleave.

(To be read before the Mechanical Section, February 27, 1908.)

The mechanical equipment of this branch of the Royal Mint was completed by the end of October last—the time occupied in the manufacture and installation of the necessary machinery having been just ten months.

Many machines in the Coining Department have been designed specially for the Ottawa Mint, and in these new devices have been adopted which are [illegible] to be found in other similar institutions. In addition to the n[illegible]inery in that department, where the actual minting of money takes place, the following plants have also been installed:

(i) The Electrical Plant, for power distribution, for lighting, etc.

(ii) The Oil-fuel Plant, for storing and distributing the oil-fuel used throughout the various departments in the melting, annealing, and cupel furnaces together with the fans and blowers for the same.

(iii) The Die-making Plant, for sinking, turning, annealing, and hardening the dies used for coinage purposes.

(iv) The Plant for the Boiler House and the Machine, Smith's, and Carpenter's Shops, in which all running repairs are effected and small tools made.

(v) The Plant for the Assay Department, where all the precious metals received into and issued from the Mint are analysed; and in which experimental research work will be conducted.

To give a full and complete description of all the mechanical devices which have been installed throughout the Mint would make this paper unduly long. Each of the plants enumerated above will therefore be briefly dealt with in turn, in the order given; and then the Coining Department, which contains types of machines probably less commonly known than the rest, will be described more at length.

Electrical Plant.

Electrical Equipment.—The electricity used for power and lighting is supplied in the form of a two-phase, alternating current, and enters the building at a potential of 2,140 volts. It then passes through the transformers, of which there are three for power and three for light. In each case one is a spare which can be put into circuit, on either phase, by operating the primary and secondary switches.

The transformers for power operate the motor of a motor-generator set. They are single phase, step down, oil insulated, self cooled, for a circuit of 60 cycles. The primaries are wound for a potential of 2,140 volts, and the secondaries for a potential of 500 volts. Their normal full rating is 100 kilowatts each.

The transformers for light operate the electric light system of the building. They are similar to the transformers for power, but the secondaries are wound for a potential of 107-214 volts; while their normal full rating is 15 kilowatts. The primaries and secondaries of each transformer are provided with binding posts, so that any one of them may be connected or disconnected without soldering to leads, or cutting wires.

The motor-generator set for transforming the current to operate the motors throughout the Mint consists of an alternating current motor and continuous current generator. The motor is of the two-phase, alternating current, induction type, operating from the transformers at a potential of 500 volts: its normal full rating being 225 H. P., at a speed of about 800 revolutions per minute. The generator is multi-polar, compound wound, continuous current, operating at a potential of 225 volts: its normal full rating being 150 kilowatts. The motor and generator are on one bed plate, and supplied with auto-starter for the motor, and field rheostat for the generator.

There are 32 compound-wound, continuous current motors in use, ranging in power from 1¼ H. P. to 30 H. P., all operated at a potential of 220 volts.

The wiring for the motors is of the parallel two-wire system, the wires being carried in steel conduits.

The wiring for the lighting is of the interior conduit system;

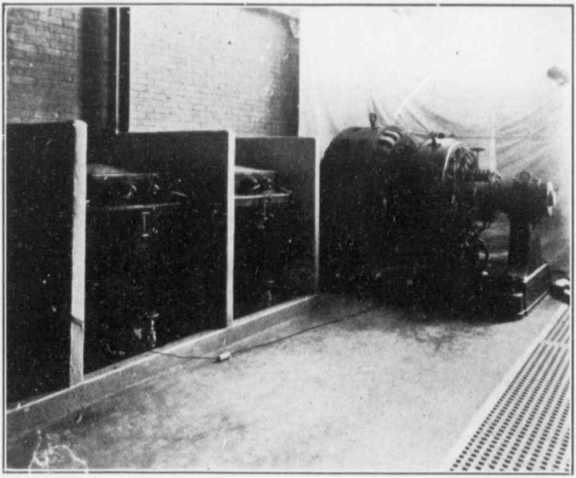

Fig. 1—Motor-generator set and power transformers.

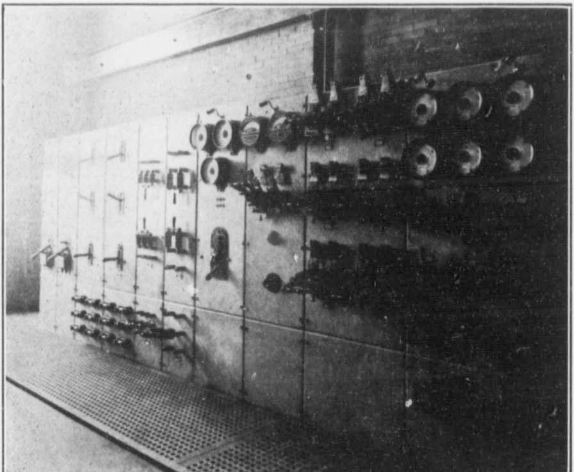

Fig. 2—Main switchboard in power room.

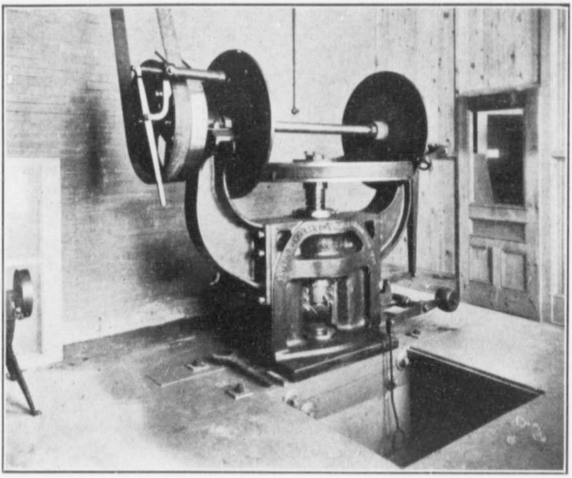

Fig. 3—Die-sinking press in Die Department.

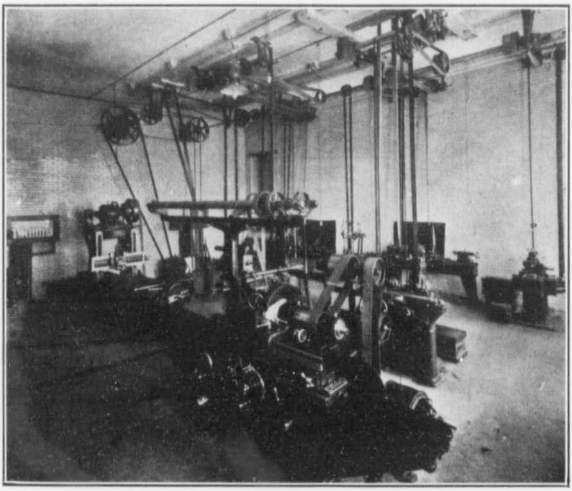

Fig. 4—Machine Shop.

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all the main circuits being of three wires, and the branch circuits of two wires.

There are 415, 3.5 watt, 16 C. P. 102-volt incandescent lamps, and 17 arc lamps. The latter are of the enclosed type for multiple circuits, adjusted for 7 amperes and 107 volts, alternating current.

The buildings are wired for electric clocks, bells, and telephones, which are in use throughout the Mint.

Oil-Fuel Plant.

Oil-Fuel Equipment.—The fuel used for melting and annealing purposes, and for the cupel furnaces in the Assay Department, is crude oil; its specific gravity being .850. The plant for storing, distributing, and burning this fuel consists of:—Four storage tanks (each of 2,000 gallons capacity), two rotary pumps for distributing the oil throughout the buildings, three pressure blowers, four melting furnaces for crucibles holding 90 lbs. each, one strip annealing furnace, one blank annealing furnace, one die hardening furnace, and three cupel furnaces and two small melting furnaces for the Assay Department. In the melting and cupel furnaces an air blast is used in conjunction with the oil; while in the annealing furnaces and die hardening furnace dry steam is used, at a pressure of 60 lbs. per square inch. The oil pumps are so arranged that the fuel is delivered to the furnaces at constant pressure. All oil pumped, but not used, is returned through a spring-loaded valve to the storage tanks.

The tanks are supported on concrete bearers, one at either end, and one at the centre of each tank—so that the air may circulate freely around them. The piping for these tanks is so arranged that each one may be filled or emptied separately. Each tank is also fitted with a return pipe from the pumps, and a vent pipe through which all fumes rising from the oil are lead to the roof of the building. The air for the blast used in the melting furnaces is drawn from the tank room, so that the air round the tanks is constantly changed.

This fuel is found to be very economical, and excellent results have been obtained from all the furnaces. The heat can be regulated without difficulty, and, in the melting furnaces, either nickel or aluminium may readily be melted.

Die-Making Plant.

Die Department.—The machinery in this department consists of a die-sinking press, two die-turning lathes, and a die-hardening furnace. The press and lathes are driven by a motor through an overhead shaft. In the die press the blow is given by a heavy fly-wheel, 5 feet in diameter, which is keyed to a triple screw of 6 inches diameter. The fly-wheel is actuated by two rapidly-revolving discs which can be brought into contact with its leather-covered rim. One friction disc raises, and the other depresses the screw. The operator works the press by depressing a stirrup rod with his right foot. This action brings one of the friction discs into contact with the rim of the fly-wheel, and thus the required blow is given to the die. On the operator withdrawing his foot, a balance weight raises the stirrup, the other friction disc comes into operation, and the screw is raised. After the blow has been delivered, the height to which the screw shall rise is regulated by a brake adjustment; and having reached that height, it remains there until the stirrup is again depressed. In this press a blow may be given varying from a few pounds to about forty tons.

Each coinage die requires three blows from the punch before the impression received is sufficiently sharp in all its details. After each of the first two blows the die is annealed in the die furnace. After the third blow it is turned to the correct size, and then hardened and tempered; after which it is ready for use in the coining press. It is usual for a pair of dies to strike about 80,000 pieces before they are unfitted for further use.

Machine Shops.

Repair Shops, etc.—In the machine shop the following tools have been installed:

One 14-inch by 72-inch Norton roll grinding machine.
One Brown & Sharpe No. 13 universal grinding machine.
One Brown & Sharpe No. 2 milling machine.
One Bertram planing machine.
One Barnes 21-inch drilling machine.
One sensitive drill.
One 16-inch gap lathe.
One 14-inch Pratt and Whitney lathe.
One shaping machine.
One polishing spindle.

In addition to the above, fitters' benches, grindstone, power hacksaw, etc., have been installed.

The roll grinder and the planer are driven by their own motors, while the other machines are grouped.

An elevator is situated in one corner of the shop, communicating with the smith's shop, which is in the basement next to the boiler room.

The smith's shop contains a Buffalo down draft forge, a Fairbanks' 100-lb. power hammer, shearing machine, etc.

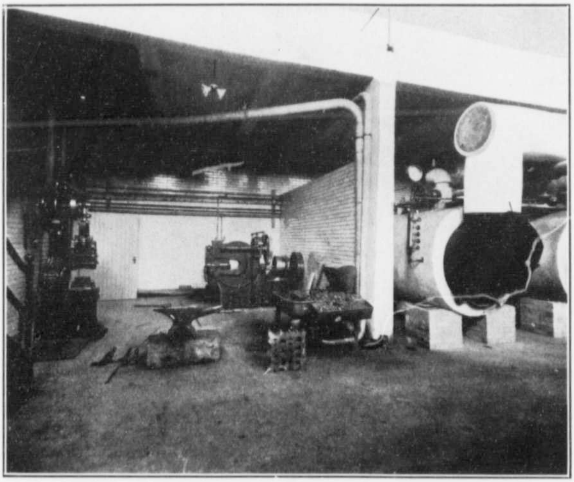

Fig. 5—Boiler House and Smith's Shop, showing two marine type high pressure boilers, power hammer, shearing machine, and "Buffalo" down draught forge.

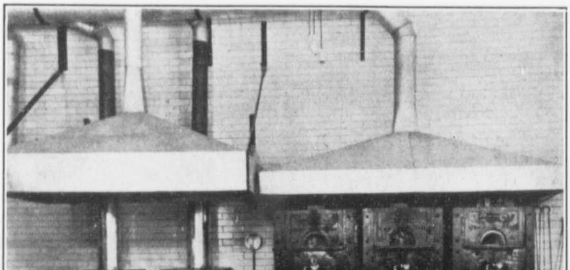

Fig. 6—Cupel and melting furnaces in Assay Department.

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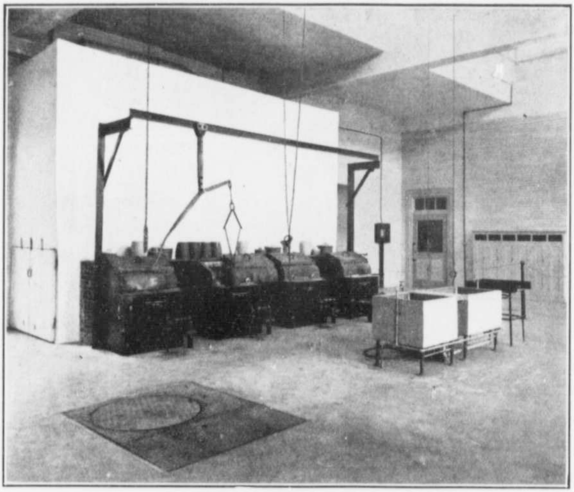

Fig. 7—Melting furnaces, condensing chamber, acid and water tanks in Melting House. The granulating tank is situated under the iron plating shown at the left of the foreground, and is fitted with water supply, over-flow and waste pipes, and settling tank.

Fig. 8—Shearing machine, rotary files, and assay cutter in Melting House.

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The boiler room is equipped with two marine type multitubular boilers, which are used for heating the Operative Department, by steam, during the cold weather; for supplying hot water throughout the buildings; and for supplying steam to the annealing and die furnaces, and to the drying apparatus. Hard coal is used in these boilers, and a pressure of 80 lbs. per sq. in. is maintained. The boilers are fitted with connections so that either, or both, may be used for any of the above services. The steam for heating the building, before entering that system, passes through a reducing valve, so that the pressure is reduced to 10 lbs. per square inch. The returns from the heating system are lead to a hot-well, and are returned to the boilers by a duplex feed pump. The boilers may also be fed by means of a Pemberthy injector, or direct from the mains, in case of necessity, and when the steam pressure is below 40 lbs. per square inch.

The carpenter's shop is in the basement, next to the smith's shop, and contains a variety saw, a 12-inch wood turning lathe, and a carpenter's bench. The saw and the lathe are driven from an overhead shaft by a motor, which also drives the shafting for the blacksmith's shop.

Assaying Plant.

The Assay Department.—This department is situated in the front building, and occupies three floors. In the basement the motors and blowers for the furnaces are installed, and here also are stored the acids, chemicals, etc. The furnace room is on the ground floor, and contains three cupel and two melting furnaces; all heated by oil-fuel in conjunction with an air blast. The second floor is occupied by the laboratory and scale rooms.

In this department is an elevator, communicating with all three floors, which may be used either for passengers or for the conveyance of apparatus, acids, etc., to the various rooms. Additional communication between the three floors has also been provided, in the form of a spiral stairway. Fume chambers have been installed in the laboratory and furnace room, together with the necessary chemical and physical apparatus for assay and experimental work.

The Coining Department.

For the purpose of describing the machines used in the actual processes of minting, it may perhaps prove interesting, and more intelligible, if the various operations through which the metals pass while being transformed from ingots into finished coins, are stated in order of sequence, and then are dealt with separately.

A short description of each machine and the part it takes in the production of the coins will in each case be given.

The operations are as follows:—Melting, rolling, adjusting, cutting, marking, annealing, blanching and cleaning, coining, testing.

Melting.—The ingots (of a purity of 999 parts per 1,000, or over) are placed with the necessary alloy in the crucibles, and charged into the melting furnaces. There are four of these furnaces altogether, each one taking a No. 30-35 crucible (about 90-110 lbs. of silver). Crude oil is used as fuel, in conjunction with an air blast. The oil (sp. gr. 32-34 B.) is delivered to the furnaces in very fine streams at a pressure of about 25 lbs. per square inch, and is mixed with air from a low pressure blower (air blast about 10 ozs. per square inch).

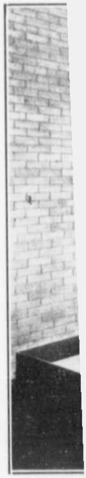
The flame does not play directly on the crucible, but first strikes a fire-brick, and is then deflected so as to travel round the crucible, and then to the flue.

These furnaces are very clean, economical and easy of manipulation. It is usual, in the case of silver, and starting with a cold furnace, for the first round to be ready for pouring one and a half hours after lighting up. After the first round has been poured the furnaces have become thoroughly warmed up, and the subsequent rounds are ready for pouring one hour after charging in. It will thus be seen that in an ordinary working day of eight hours metal can be poured six times from each furnace.

The flues are so arranged that the gases issuing from the furnaces enter a large condensing chamber, where they expand rapidly, and their velocity is reduced. In passing through these chambers the gases strike against bafflle-plates (the course taken by them being in the form of the letter S placed on its side), by means of which their velocity is still further reduced. Any fine particles of metal which may be carried by them from the furnaces are deposited on the baffle-plates and sides of the chambers, and are thus prevented from being carried away through the chimney stack.

This treatment of the gases results in the saving of a considerable amount of metal, as is clearly shown in the annual report of the Director of the United States Mint. From this report it appears that, after six months' working, the value of the metals recovered from the condensing chambers attached to 13 furnaces was no less than $12,900.00.

After the metal has been melted, it is poured into cast iron moulds, forming bars about 24 ins. long, ½ in. thick, and varying in width from 1¼ ins. to 2¼ ins., according to the denomination of coin to be made. The newly-formed bars are removed from the moulds as soon as they have become solid, and plunged in a weak



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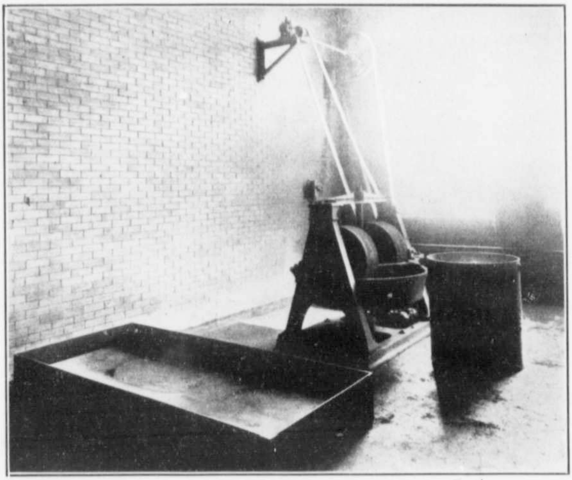

Fig. 9—Mortar mill for reducing worn-out crucibles, etc., for the recovery of precious metal.

Fig. 10—Rolling mills. Fillet-annealing furnace on right.

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Fig. 12—Gen
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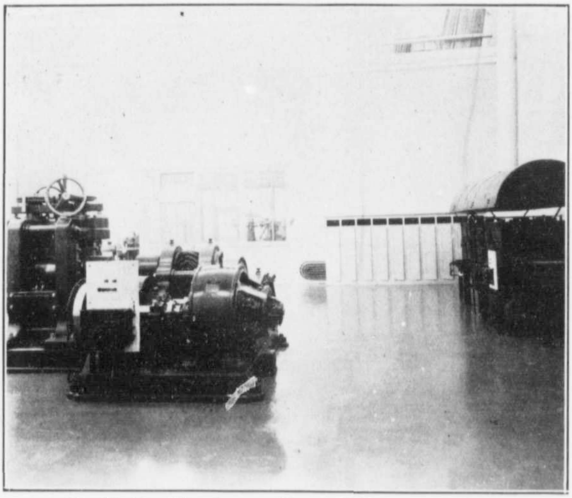

Fig. 11—Breaking-down mill and fillet-annealing furnace.

Fig. 12—General view of Rolling and Adjusting Room, showing draw-bench, automatic trying cutter, and scale room.

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solution of sulphuric acid; after which they are washed and dried. They are then taken to the shearing machine and revolving files, where the spongy ends are removed, and the rough edges trimmed. They are then ready for the rolling mills.

The shearing machine is of the usual single-ended pattern, such as used in machine shops, fitted with fast and loose pulleys, and driven from an overhead shaft.

There are two revolving files, each consisting of a headstock, with shaft, and single pulley between the bearings. On one end of the shaft, outside the bearing, is keyed a circular file of about 6 ins. diameter and 6 ins. long. These files are also driven from the same overhead shaft as the shearing machine, and revolve at 150 revolutions per minute. The bars from each crucible are kept separate from those from any other crucible, and are marked with distinctive letters and figures, so that their origin can be readily traced at any time. A small piece is cut from one end of the first and last bar from each crucible, and these pieces are forwarded to the Assay Department for testing purposes. The bars are not operated upon until the report from that department has been received stating that they are within the legal remedy as to fineness. All bars which are above or below the legal standard are re-melted with the necessary amount of alloy, or fine metal, to bring them within the remedy.

All the worn out crucibles, covers, etc., are ground to a fine powder in a mortar mill; the powder being washed, so as to recover any metal that may have been taken up during the process of melting.

The powder is washed twice, after which it is sold by public tender, the tendering firms being allowed to take samples beforehand.

The mortar mill used for reducing the worn-out crucibles, etc., is fitted with an under-driven revolving pan, five feet in diameter, has fast and loose pulleys, and is driven from an overhead shaft by a 5 H. P. motor. After the powder has been washed, it is dried in a steam-heated drying pan, 8 feet long, 4 feet wide, and 10 inches deep. It is then thrown into bins, where it is stored until sold.

Rolling.—When designing these mills arrangements were made to provide for extremely accurate and very fine adjustments for the rolls, for all the driving mechanism to be kept above the floor level (the ground being rock, and very hard to excavate) and for economy of floor space.

Each mill is driven by its own motor, through gearing; the general arrangement being as follows:

The motor, gearing, and roll housings are all on one bed-plate, thus ensuring rigidity and perfect alignment. The first motion shaft carrying the driving pinion runs in its own bearings and, at one end, is connected with the motor through a flange coupling outside one of the bearings. The driving pinion is situated between these bearings, so that the motor is entirely free from any thrust. At the other end of this shaft, outside the other bearing, a small fly-wheel is keyed. The second motion shaft gears with the shaft driving the bottom roll, and this latter shaft gears through double helical gearing with the shaft which drives the top roll.

The rolls are connected with the gearing by means of breaking spindles and muff couplings. The couplings are held up to their work by adjustable wood distance pieces.

The motors run at 600 revolutions per minute, and the rolls at from 40 revolutions per minute, for the breaking down mill, to 60 revolutions per minute for the finishing mill.

The form of drive described above is found to be very convenient, and to absorb very little power.

The breaking down mill is driven by a 30 H. P. motor fitted with an overload release, which is set to cut out at 50 per cent. overload. The distance between the rolls is regulated by means of worms and worm wheels actuating large, single, square thread screws of ½ inch pitch. There are 50 teeth in each worm wheel. The worn shaft is divided in the centre, the halves being connected by means of a friction coupling, so that when it is necessary to "parallel" the rolls, one end only of the top roll may be moved at a time. This worm shaft is actuated by hand wheels at either end, one complete revolution of which closes or opens the rolls .01 inch. The hand and worm wheels are fitted with indicators and divided circles, so that adjustment of the rolls can be made as fine as .0005 inch. For ordinary rolling it is usual to work to .001 inch at this mill.

It has been found difficult, with the form of adjustment detailed above, to prevent the top roll from jumping when the bar which is being reduced first enters between the rolls. This jump may arise from the three following causes:

Firstly, there may be slackness between the roll journals and bearings.

Secondly, there may be looseness in the attachments between the bottoms of the big screws and the caps of the roll bearings.

Thirdly, there may be wear between the big screws and the threads of the nuts in the roll housings.

When it is remembered that the weight of the top roll with its brasses and adjusting gear amounts to about two tons, it can be readily imagined that signs of wear will soon become apparent between these nuts and screws.

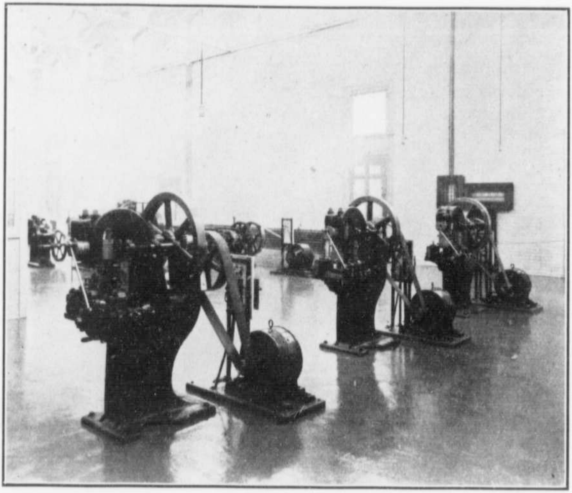


Fig. 13—Cutting-out machines.

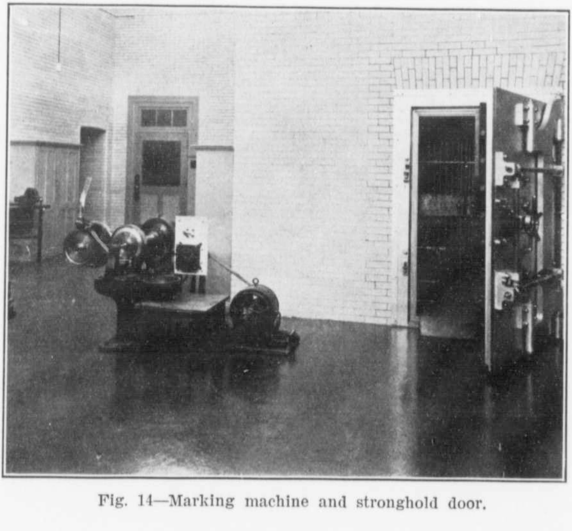
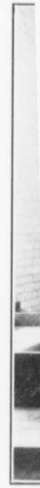


Fig. 14—Marking machine and stronghold door.



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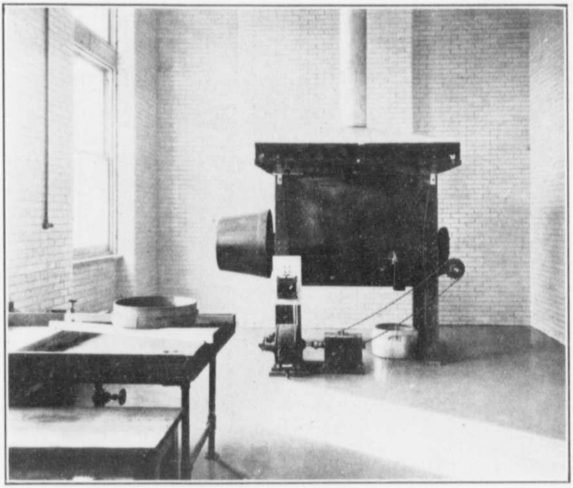

Fig. 15—Rotary blank-annealing furnace and sawdust-drying plate.

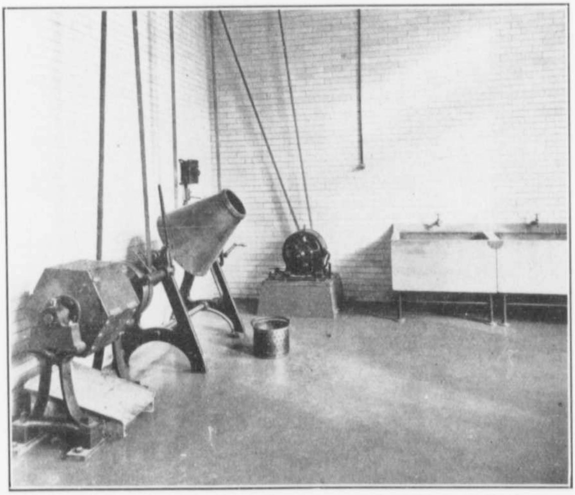

Fig. 16—Tumbling barrel, drying drum, and washing tanks in Annealing Room.

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Various devices have been tried with a view to prevent this jumping of the top roll; a common one being that of heavy weights, situated in a tunnel below the floor level, which act through levers and rods to counterbalance the weight of the top roll and gearing. This method, however, does not entirely overcome the difficulty.

In order to avoid excavating for a tunnel, the following arrangement has in this case been adopted, and there is every reason to hope that it will be entirely successful in preventing the jump of the roll:

The top of each roll housing has been extended on one side so as to form a hollow casing in which a powerful buffer spring is situated. Each spring is of sufficient strength to take, when half compressed, the entire weight of the top roll with its brasses and adjusting gear.

When the top roll is depressed to within one inch of the bottom one, these springs come into full play, and thus keep the big screws which actuate the top roll in close contact with the upper side of the threads in the nuts. There is thus no weight on the bar that is being rolled other than the intentional pinch given to it through the gearing.

This arrangement has been thoroughly tested and, up to the present, the top roll has shown no sign of jumping. The bars so rolled into "fillets" have been carefully gauged and found to be remarkably uniform throughout their entire length.

The rolls in this mill are 14 inches in diameter and 16 inches in length, and are driven at 40 revolutions per minute.

The thinning mill is driven by a 20 H. P. motor in the same manner as the breaking down mill. The adjustment of the rolls is also the same, but the gearing, etc., is, of course, of somewhat lighter construction.

The rolls in this mill are 12 inches in diameter and 14 inches in length, and are driven at 50 revolutions per minute.

The finishing mill is driven by a 10 H. P motor in the same manner as the others; but the adjustment of the rolls is different. The distance between the rolls is varied by raising or lowering the bottom roll by means of long steel wedges, which are actuated by a hand wheel through gear wheels and fine screws. The hand and gear wheels are fitted with indicators and divided circles, so that adjustment of the rolls can be made as fine as .0002 inch.

The rolls in this mill are 10 inches in diameter and 12 inches in length, and are driven at 60 revolutions per minute.

The bars from the Melting Department are first passed 10 or 12 times through the breaking down mill, after which they are annealed in the fillet annealing furnace. They are then passed 8 or 10 times through the thinning mill and 5 or 6 times through the finishing mill, when they should be the correct thickness for the coin that is to be made. For silver and bronze coins, rolling is sufficiently accurate; but for gold, further treatment is necessary. This latter metal is very dense, having a specific gravity of about 19 as against about 10 for silver and about 9 for bronze. The variation allowed by law from a standard weight is also, in the case of gold coins, very small. For instance, the standard weight of a British sovereign is 123.274 grains, but the remedy allowance is only .2 grain. If the coin exceed this limit, by even so little as .01 grain, it is rejected, and re-melted. The remedy allowance on silver coins is much more generous, weight for weight; being between two and three times as great as for gold.

The fillet-annealing furnace is heated by oil-fuel mixed with steam at 60 lbs. pressure per square inch. The floor of the heating chamber is composed of three endless chains, travelling side by side, and driven by sprocket wheels situated at either end of the chamber. The speed at which the chains travel can be varied by means of a speed box attached to the driving motor; so that the time occupied by a fillet in passing through the furnace may be from 4 to 12 minutes. The fillets are laid flat on the travelling chain, 5 or 6 side by side, and as they emerge, pass through a sheet of water; so that they are cooled before they come into contact with the air. This arrangement prevents oxidation, and very little, if any, discolouration is noticeable.

Adjusting.—In the case of silver and bronze, the fillets pass from the finishing mill to the blank cutting machines; but, in the case of gold, as before stated, it is found that further adjustment is necessary. The gold fillets are accordingly taken to the draw-bench, where they are drawn between two fixed steel cylinders by means of a dog-clutch which engages with an endless chain. These cylinders are about 4½ inches long and ¾ inch in diameter; they are highly polished, and extremely hard, and the distance between them can be adjusted to .0001 inch. By this means the small inequalities in the thickness of the fillets are regulated, and their variation from standard is reduced to a minimum. The fillets then pass to the blank-cutting machines.

Cutting.—There are three of these machines, each one driven by a separate motor, and capable of cutting blanks for all sizes of coins, at the rate of 300 per minute. The punches and beds for all the different denominations are interchangeable, so that little time is occupied in changing from one to another. Each machine is fitted with an automatic variable feed, which can be increased or decreased by multiples of .05 inch.

After the blanks have been cut from the fillets, the skeletons that

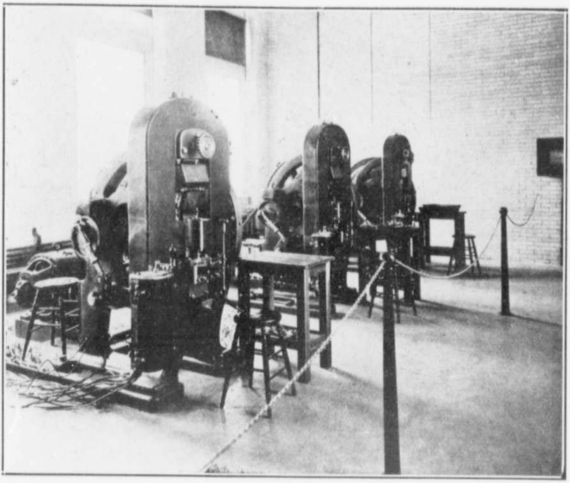

Fig. 17—Coining presses.

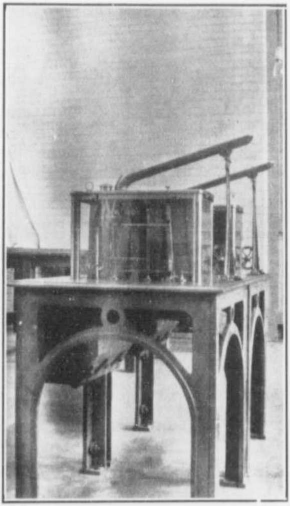

Fig. 18—Automatic weighing machines.

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are left (technically known as "scissel") are cut up into convenient lengths, and made up into bundles for re-melting.

Marking.—The blanks are next taken to the marking machine, where raised edges are formed round their circumferences. These raised edges protect the impressions which will be given to them later in the coining presses, and thus prevent their being rapidly worn away. This machine is capable of marking 600 blanks per minute. The blanks pass between a circumferential groove, in a rapidly-revolving hard steel disc, and another groove, struck from the same radius, in a fixed hard steel block. The distance between the disc and the block can be varied, so that any size of blank may pass between them. The blanks are then annealed, and thoroughly cleaned.

Annealing.—The blank annealing furnace is heated in the same manner as the one used for annealing the fillets; but the arrangements for passing the work through is different. The blanks are fed into the machine through a sheet iron hopper. This hopper is attached to, and revolves with a cast iron hollow cylinder, on the internal surface of which is cast a hollow thread of very coarse pitch. The blanks follow this thread, moving forward slowly as the cylinder revolves, until they fall through an opening which communicates with a shute leading into a vessel containing water. The flame surrounds the cylinder, which is kept at a red heat during the process of annealing. The time taken by the blanks in their passage through the furnace is regulated in the same manner as in the fillet annealing furnace. The blanks are cooled before they come into contact with the air, and oxidation is thus prevented.

Blanching and Cleaning.—After having been annealed, the blanks are cleaned in a weak solution of sulphuric acid; washed and dried; they are then ready to receive the impression from the dies. The solution of sulphuric acid is contained in a copper tumbling barrel which revolves at about 40 revolutions per minute, and is so designed that it can be tilted for filling and emptying. After treatment by the acid, the blanks are washed in tanks containing hot and cold water, and are then placed in the drying drum with beech-wood sawdust. Beechwood is used for this purpose because it contains no resin, or other ingredient likely to discolour the blanks or make them adhere to one another. The drying drum is hexagonal in section, the sides made of hard wood, and the ends and attachments of brass. This drum revolves at about 25 revolutions per minute, and the blanks and sawdust remain in it for about ten minutes. They are then tipped into a circular sieve, and shaken over the hot-plate. The mesh of the sieve is large enough to allow the sawdust to pass freely through the bottom but small enough to retain the blanks. The hot-plate consists of a flat sheet iron pan about 6 feet long, 4 feet wide, and with sides 6 inches high. It is supported on four iron legs, and stands about 3 feet 6 inches from the ground. Beneath the pan, and in close contact with it, is a steam coil, by means of which the sawdust is dried, and may be used over again.

Coining.—The coining presses, of which there are three, are of the type in which the pressure is given to the coins through levers and toggle-joints. The hard steel knuckles of the toggle-joints are of exceptionally large dimensions, so that coins can be struck at the rate of 100 per minute without any danger of them becoming overheated. Each press is driven by its own motor, and arranged so that the drive can be made either through a belt or gearing. The number of blows struck per minute can be varied from 30 to 100 by means of a 5-step controller.

The top and bottom dies move up and down, the collar plate remaining stationary. The blanks are placed in the feed tube by the operator, in piles of about 30. They are fed to the dies, automatically, by steel feeding fingers, which take one blank at a time from the feed tube, and drop it into the collar, at the same time pushing the previously struck piece into the delivery tube.

Hitherto, when coining, it has frequently been the case that, for some reason or other, a blank has not been placed between the dies at the proper moment. This may occur through the feed tube being empty, or through a bent blank sticking in the tube. In every case the dies have come together ("clashed"), and have been rendered useless. It has been known in a large mint for as many as 12 dies to be "clashed" in one day; representing a cost of not less than $22.00, over and above the time taken in changing the dies. As a general rule a pair should be capable of striking about 80,000 pieces before becoming unfit for further use. In order to prevent the possibility of "clashed" dies, a device has been adopted in these presses, by means of which the dies do not come together unless a blank has been placed between them. This device consists of a special clutch between the fly-wheel and the main shaft, which is actuated by an arrangement of levers connected with the feeding fingers. In the event of a blank not being fed to the dies, the clutch is released, and the column holding the top die is stopped instantly, at its highest point: the fly-wheel continuing to run idle on the main shaft. This attachment takes up no extra floor space, and is exceedingly neat and effective. By its means also, single strokes can be made by the press; a very convenient arrangement when setting a new pair of dies.

After the coins have been struck, they are pushed into the delivery tube and delivered to a bowl placed in the front of the press.

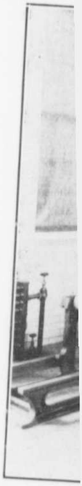

Fig.

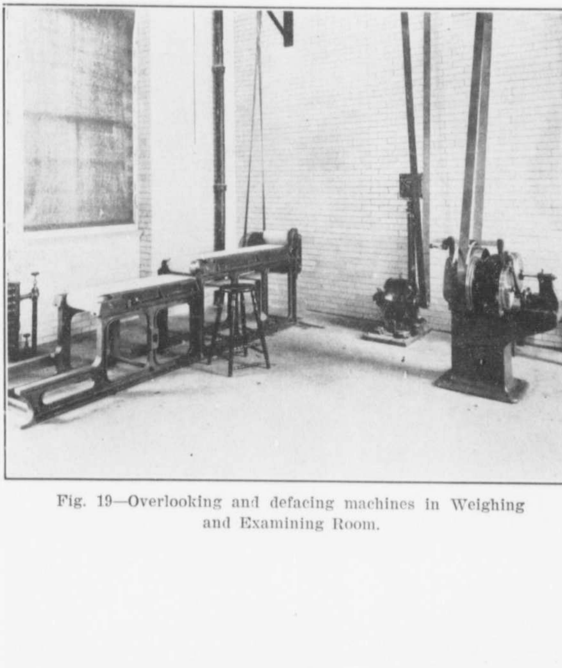

Fig. 19—Overlooking and defacing machines in Weighing and Examining Room.

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The finished coins are forwarded to the examining department, where they are subjected to various tests before they are issued.

Testing.—In the case of gold coins and 50 cent and 25 cent pieces, each one is weighed separately on an automatic weighing machine. The 10 cent and 5 cent pieces are weighed in groups, in a hand scale, against a standard dollar weight; while the 1 cent pieces are weighed, in a hand scale, against an avoirdupois pound, which should contain exactly eighty of them.

The automatic weighing machines are very delicate instruments, the weighing being so accurate that the beam, when fully loaded, will turn with .01 of a grain. Each machine will weigh 20 coins per minute. The coins are fed into a hopper by the attendant. One coin is then pushed automatically on to a flat pan attached to one end of the beam; where it remains for 3 seconds; after which it is pushed off by the succeeding coin. During the time it is resting on the pan its weight determines which one of three shutes it shall drop into when it is pushed off. These shutes lead to three boxes; one for those coins that are too light, a second for those that are too heavy; while a third receives those that are of the correct weight. The latter are taken to the overlooking machine where they are spread on a travelling band, and carefully examined. Any that are found to be discoloured or otherwise imperfect are picked out. The band travels over rollers, and, on reaching one end of the machine, the blanks are turned over automatically, so that the other side of the coins may be examined.

All the gold coins, and the 50 cent and 25 cent pieces that have successively passed through the foregoing tests, are then rung, singly, on an iron block, to find if they have the correct ring, and are not "dumb."

Those coins which have been found to be light, or heavy, or "dumb," or discoloured, or in any way imperfect, are destroyed in the defacing machine, and re-melted. The defacing machine is of similar design to the marking machine, but whereas the groove in the disc of the latter is a plain one, that in the defacing machine is divided into a series of notches, so that the edges of the defective coins are notched all the way round.

The good coins are delivered to the office, where they are counted into bags by the telling machine. This machine automatically counts, and delivers into a bag, any number of coins, as required. When the desired number have been delivered, the machine stops, until the trigger is again pulled for the next bag. Any number of coins may be counted on this machine, from 100 to 2000; and any size of coin, from 50 cents to 5 cents.

In addition to the machinery mentioned above, there are several auxiliary machines, for various purposes, throughout the coining department. Weigh bridges, for weighing truck-loads of raw metal; bullion balances, of various capacities, for weighing the metal during the processes of coining; automatic and hand trying cutters, etc.

For the storing of bullion the Mint is equipped with three strong rooms; one in the Mint Office, one in the Melting House, and one in the Rolling and Cutting Department. These strong rooms are fire and burglar proof, and are fitted with doors, each of which has four combination locks controlled by triple time clocks, and arranged so that no door may be opened without the presence of at least two officials.

A refinery will shortly be erected in connection with the Mint, in which gold will be treated by the electrolytic process.