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## Silver amalgamation

James A. Pack

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THESIS

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SILVER AMALGAMATION

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PACK

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1877

**SILVER**

**AMALGAMATION**

JAS. A. PACK  
CLASS '77.

**SILVER**

**AMALGAMATION**

JAMES A. PACK  
CLASS '77.

The process of amalgamation is one of the oldest known methods of extracting silver from its ores.

The process arose from the finding of rich silver ores in districts where little or no fuel existed.

This method of silver extraction has been known and used for over three hundred years; but the method of pan amalgamation which came into use much later and has been so fully developed under American management is the one which we will here consider.

The process of pan amalgamation is peculiarly adapted to certain mining districts of the western territory of the United States since

- 1<sup>st</sup> The climatic conditions are not suitable for the use of the process of heap amalgamation;
- 2<sup>nd</sup> Fuel is too scarce to admit of furnace operations; &
- 3<sup>rd</sup> Many rich ores are not adapted to the smelting process.

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- 2<sup>nd</sup> Fuel is too scarce to admit of furnace operations; &
- 3<sup>rd</sup> Many rich ores are not adapted to the smelting process.

When we see these various hindrances in the way of the extraction of silver from so many rich ores we can not but observe that the now widely used invention of pan amalgamation was one of the greatest steps in advance in the metallurgy of silver.

But that there is still room for improvement may be seen from the fact that in many cases there is lost by this process from 7% - 10% of the whole amount of silver obtained.

The conditions under which we will consider this process are that thirty five tons of ore adapted to amalgamation without roasting are to be treated daily.

### Crushing.

The first operation to be performed on the ores after bringing them to the place of reduction is that of crushing, and this is done by means of the stamp mill of

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which there are many varieties but which all consist essentially of an iron mortar in which works a stamp or pestal weighing from 500 to 1000 lbs.

The ores may be crushed either in the wet or dry state.

Twenty stamps are required for crushing 35 tons of ore daily, the stamps being of the given weight, being raised nine inches and giving 80 strokes per minute.

The crushed ore or pulp is drawn from the stamp mill onto a table somewhat elevated above the pan whence it is conducted to the pan.

#### Amalgamation.

The pan used in amalgamating is the McCone pan and has a diameter of 5 feet and a depth of twenty eight inches. Its capacity is about 1400 lbs at each charge; hence to amalgamate 35 tons of ore 70000 lbs ore there are required

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fifty charges of 1400 lbs each, or allowing an interval of one hour between charges for preparation there are needed ~~ten~~ pans.

Each ton of ore requires 80 lbs of mercury for the amalgamation of the silver (approximately).

The pulp is now taken from the stamps and mixed with water to the proper consistence so that it will admit of a free movement and at the same time keep the mercury suspended.

This charge is introduced into the pans and the covers placed on. The temperature of the pans should be about 200° Fahr.

The upper muller is now lowered and the grinding continued for one hour when the charge is considered fine enough for the introduction of the mercury which is now put in in the proportion of 80 lbs to the ton of ore, the mullers being raised to admit the mercury which is scattered by

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squeezing through buckskin.  
The mullers are now lowered & the grinding continued for three & one half hours, the mullers making 70 revolutions per minute.

### Settlers.

At the end of this time the amalgamation is considered completed and the charge is now considered drawn off into the settlers. The settlers consist of circular tanks in which are fixed revolving arms. These arms make 15 revolutions per minute.

The rapidity of the motion of these arms and the quantity of water added at this stage are important since a slow motion and too little water causes coarse sand to remain with the amalgam; while a too rapid motion and too much water cause a loss of mercury.

The arms of the separators disengage the amalgam from the gangue of the ore and this amalgam by

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virtue of its greater specific gravity sinks to the bottom and is thence drawn off into a bowl used for its reception.

The amalgam and mercury are cleaned in the bowl, strained, pressed, retorted melted and cast into bars.

The pulp which is run from the settlers always contains more or less mercury and amalgam, and the amount of these "tailings" is generally an index to the skill of the operators.

### Motors.

Steam is the common motor necessary to these operations unless excellent water power is near at hand. The power required for the works mentioned is as follows

Stamps	---	40	horse power
Pans, separators, &c	--	40	" "
Total		80	" "

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Stamps	40 Horse Power
Pans, Separators, &c	<u>40</u> Horse Power
Total	80 Horse Power

The stamps used are twenty in number there being two mills of ten stamps each. These stamps are shown by sections on Plate I Figs. 1 & 2.

The McCone pan is used for amalgamation and has the following dimensions

Diameter - - - - -  $5\frac{1}{2}$  feet  
Depth - - - - - 28 inches

The sections of this pan are shown on Plate II Figs 1 & 2. In fig. 2 a portion of the upper muller is removed showing the position of the shoes on both upper & lower mullers.

The separators are equal in number with the pans. They are shown on Plate III. The agitators, a, a, a are moved by gearing below, g, g. The bowl for receiving the amalgam is at b.

Plate IV gives a plan of the works. The stamps, pans & settlers are all on different

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and shafting connected with  
the engine.

A place is also supplied for  
the tailings when they are con-  
sidered rich enough for treat-  
ment.

James A Pack  
Class '77

Rolla June 17<sup>th</sup> 1876

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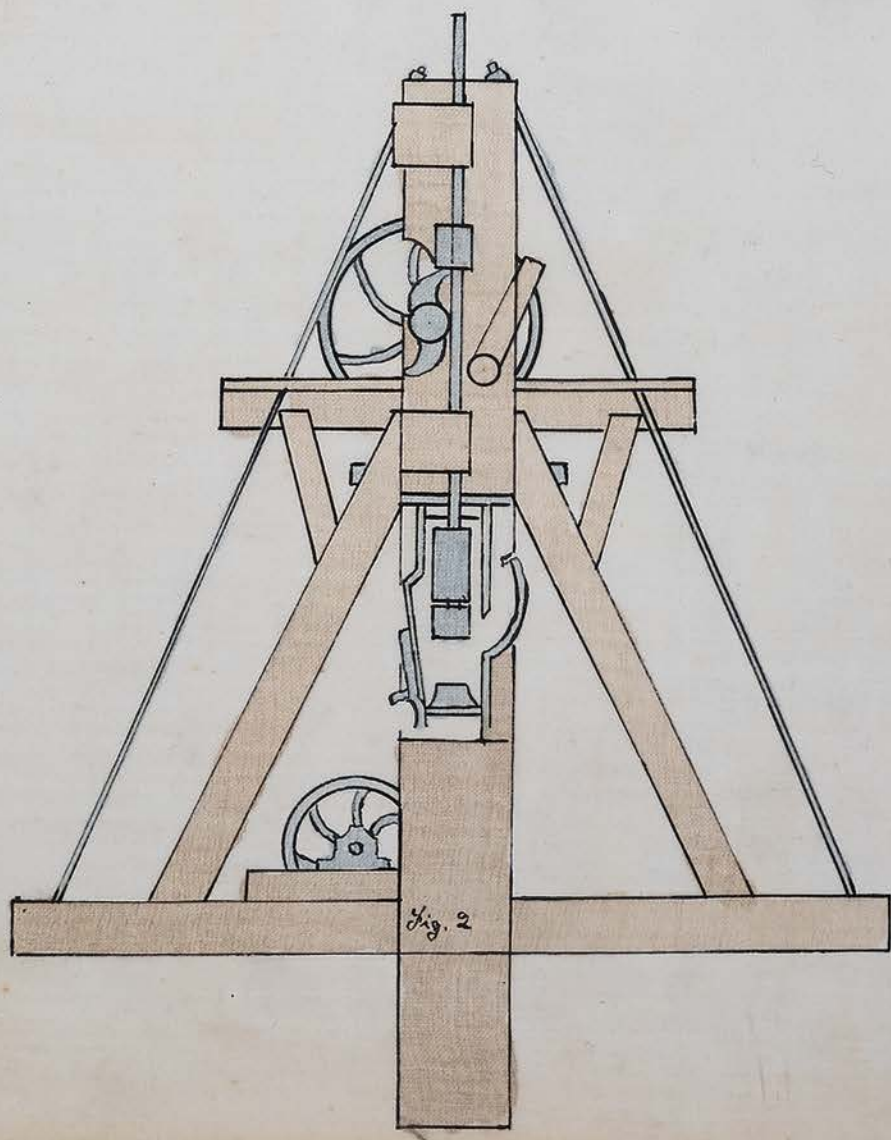
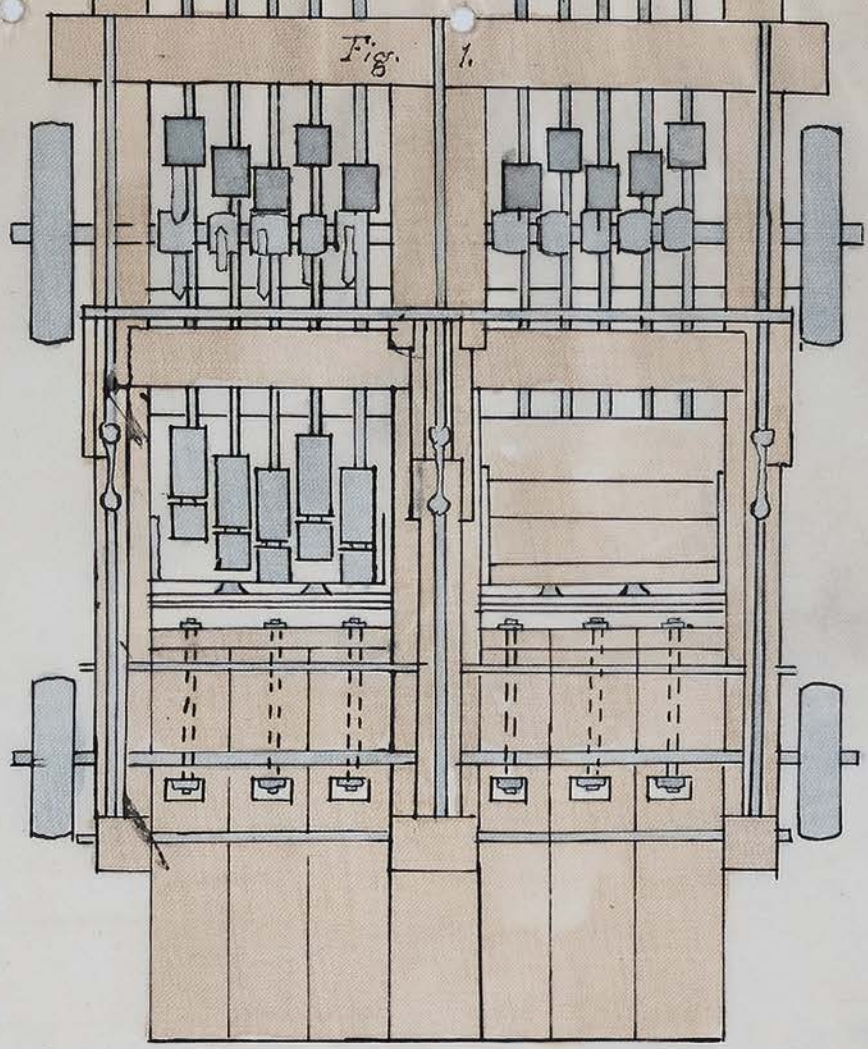


Plate II.

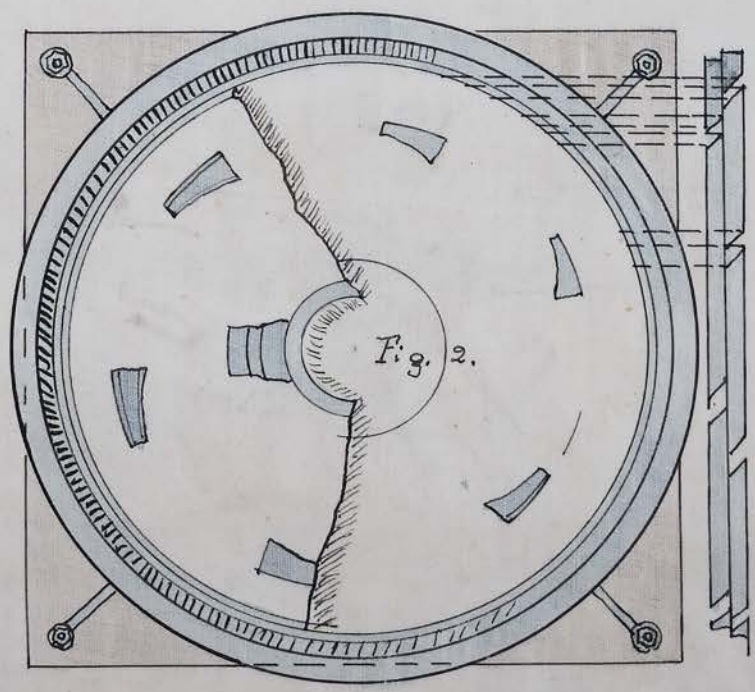
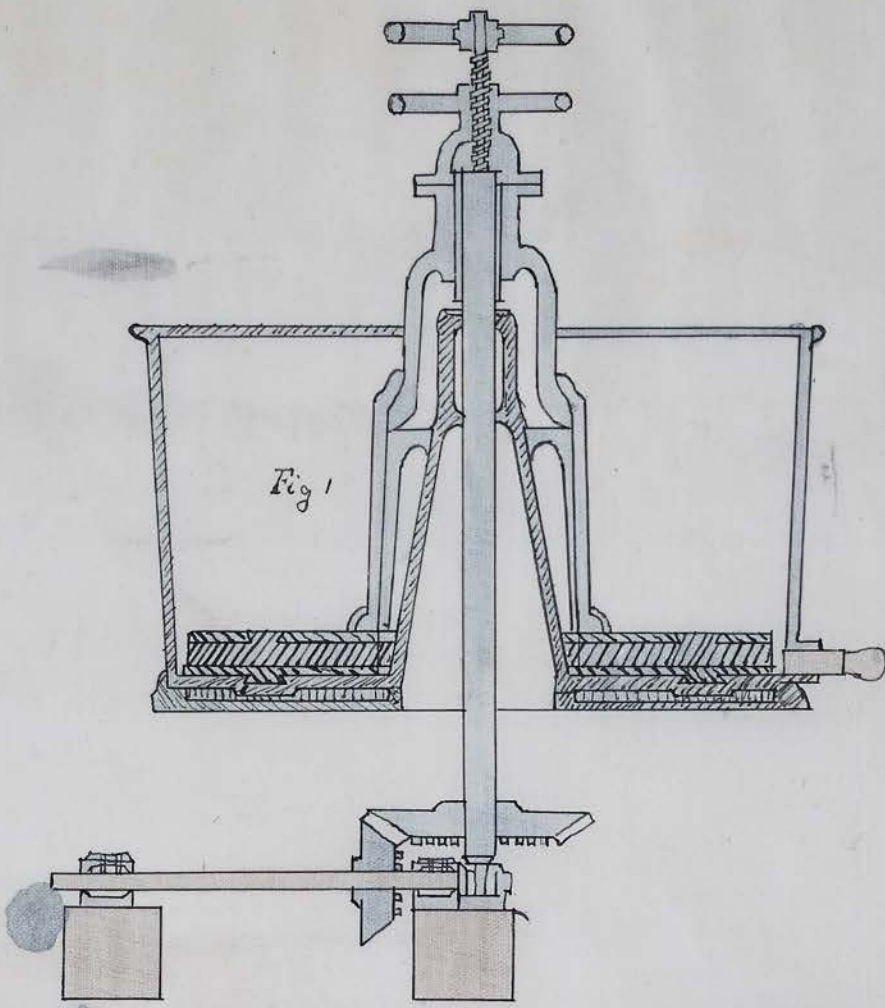


Plate III

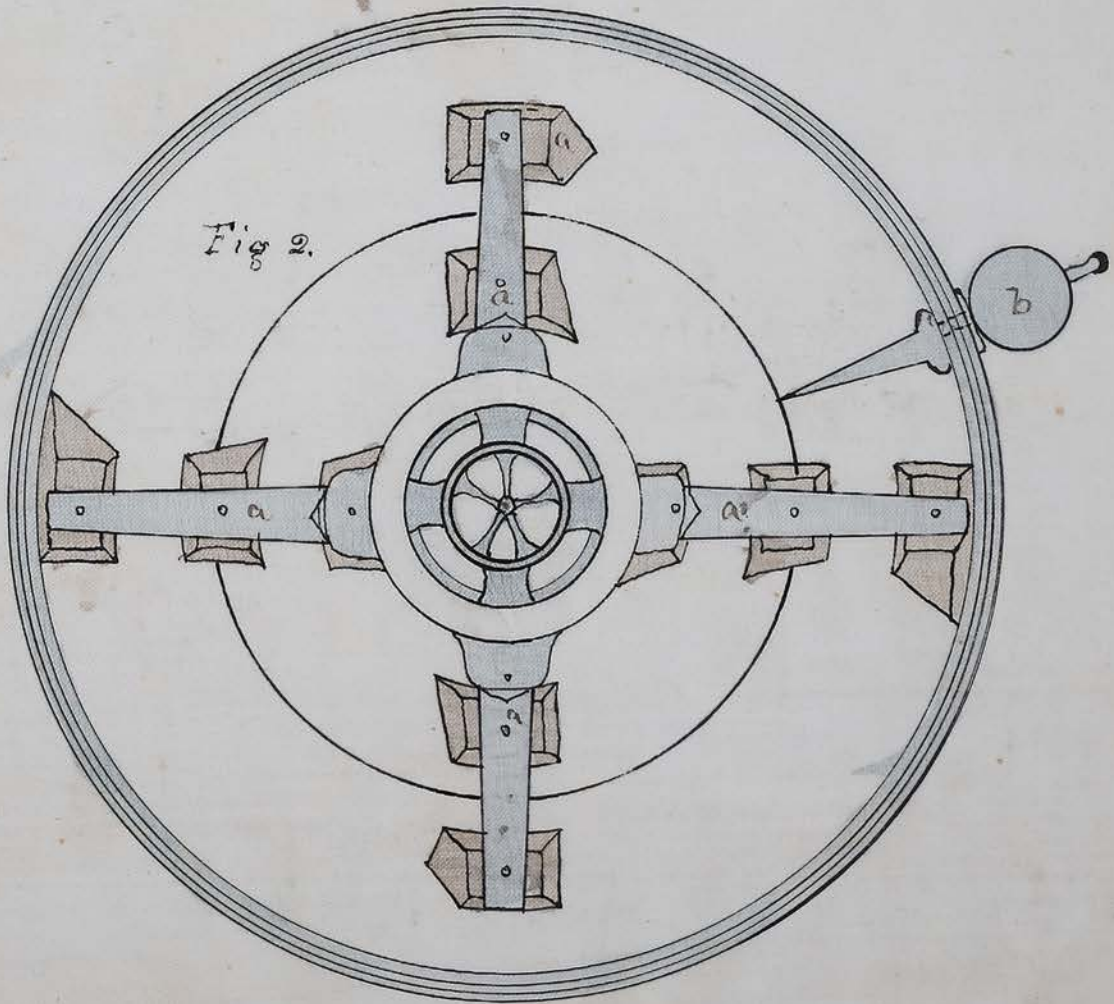
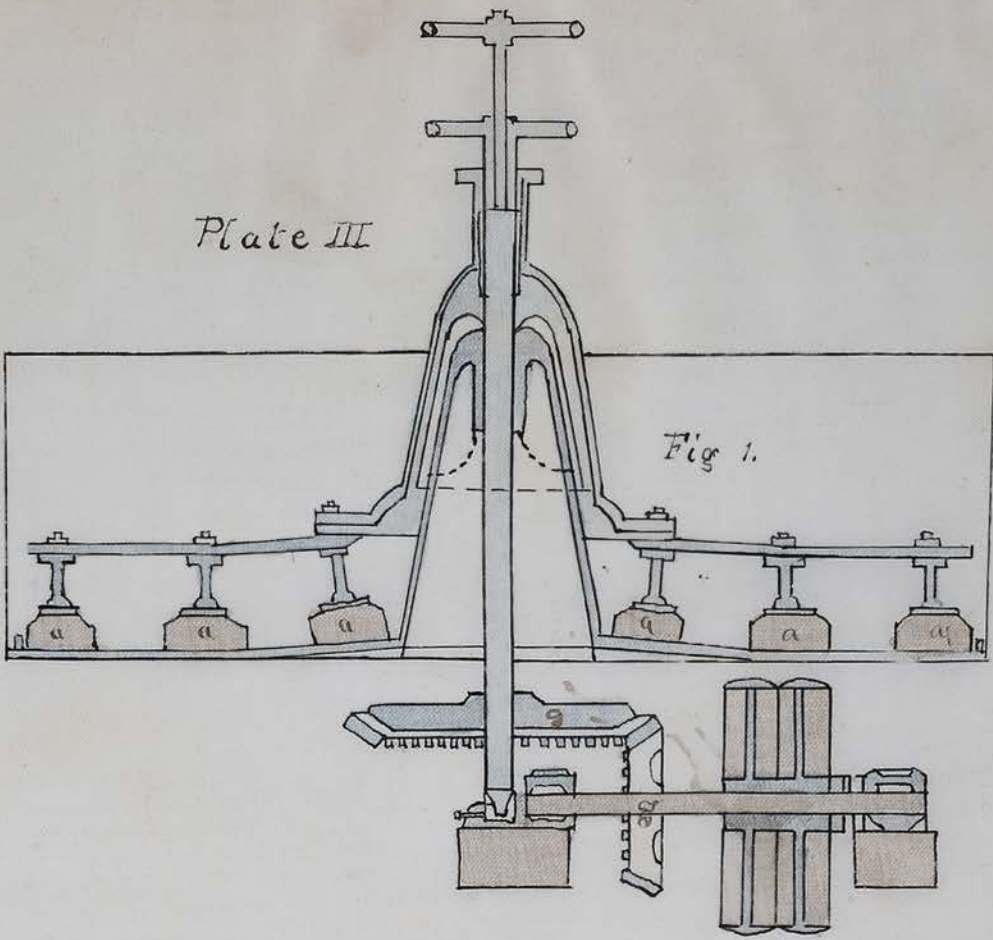
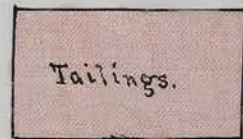
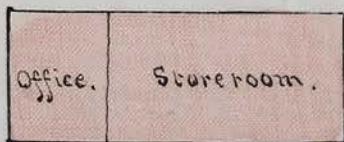
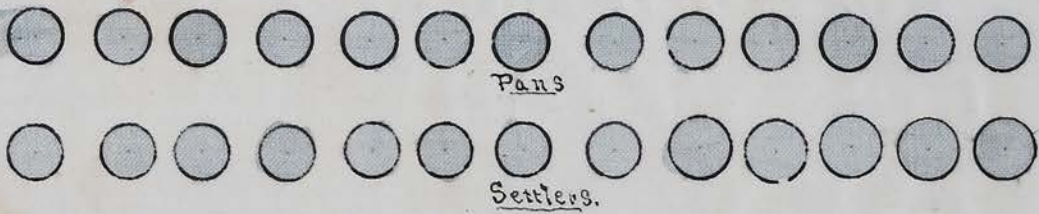
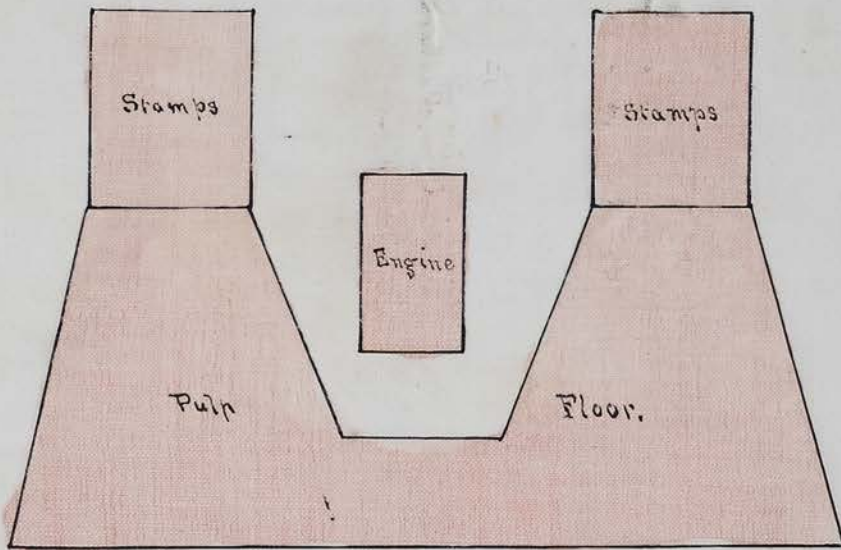


Plate IV.



Plan of Works.