1877

Silver amalgamation

James A. Pack

THESIS

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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
1st The climate conditions are not suitable for the use of the process of heap amalgamation;
2nd Fuel is too scarce to admit of furnace operations; &
3rd 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 above 1400 lbs at each charge; hence to amalgamate 35 tons of or 70000 lbs ore there are required

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 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

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 too rapid
motion and 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

virtue of it 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 ne-
cessary to these operations unless
excellent water power is neat 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	40 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 — — — 5½ 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

levels and are worked by belting
and shafting connected with
the engine.
A place is also supplied for
the tailings when they are
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Rolla June 17th 1876

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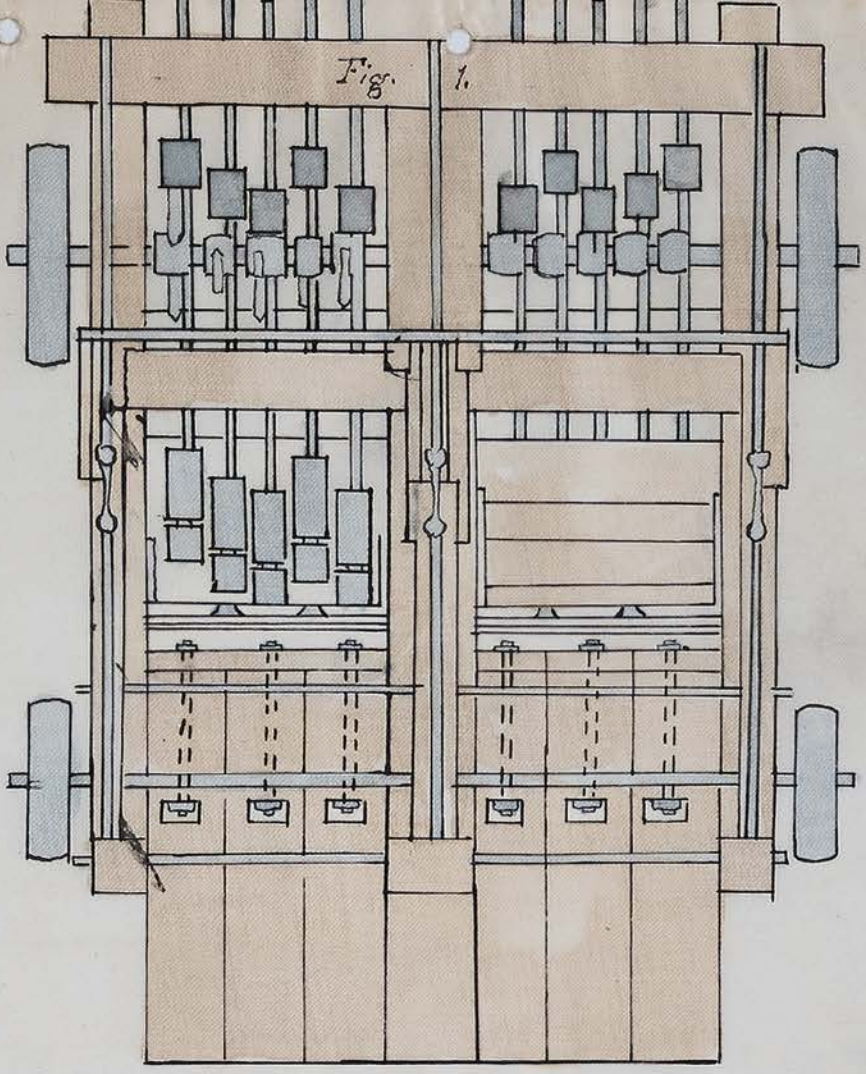
Plate I.

Fig. 1.



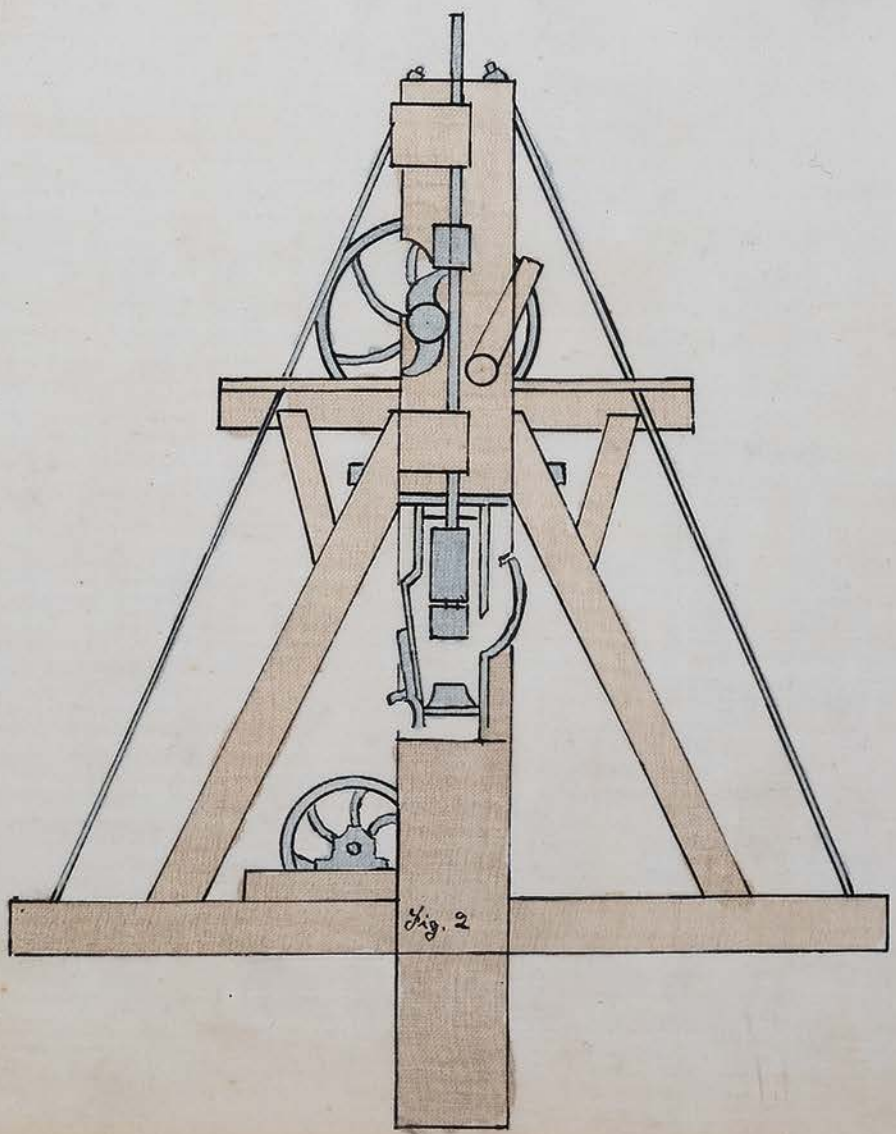


Fig. 2

Plate II.

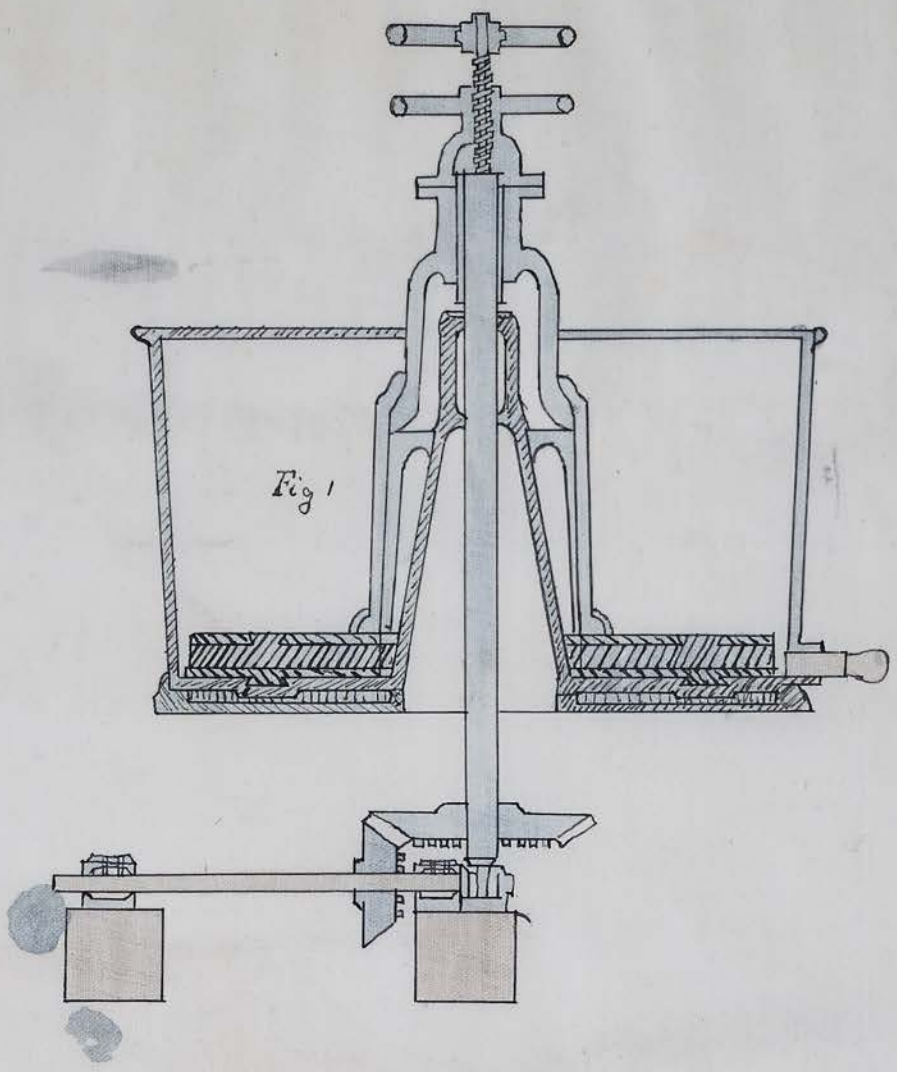


Fig 1

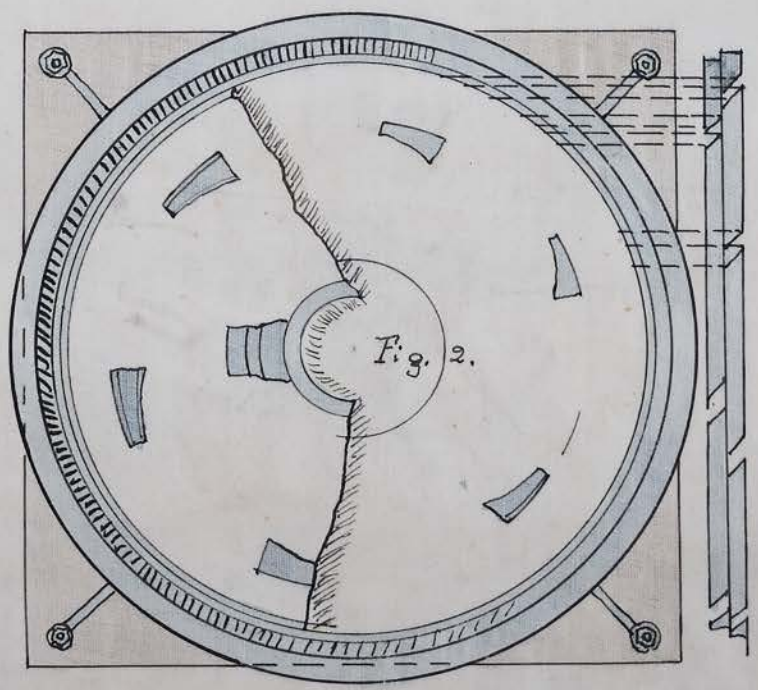
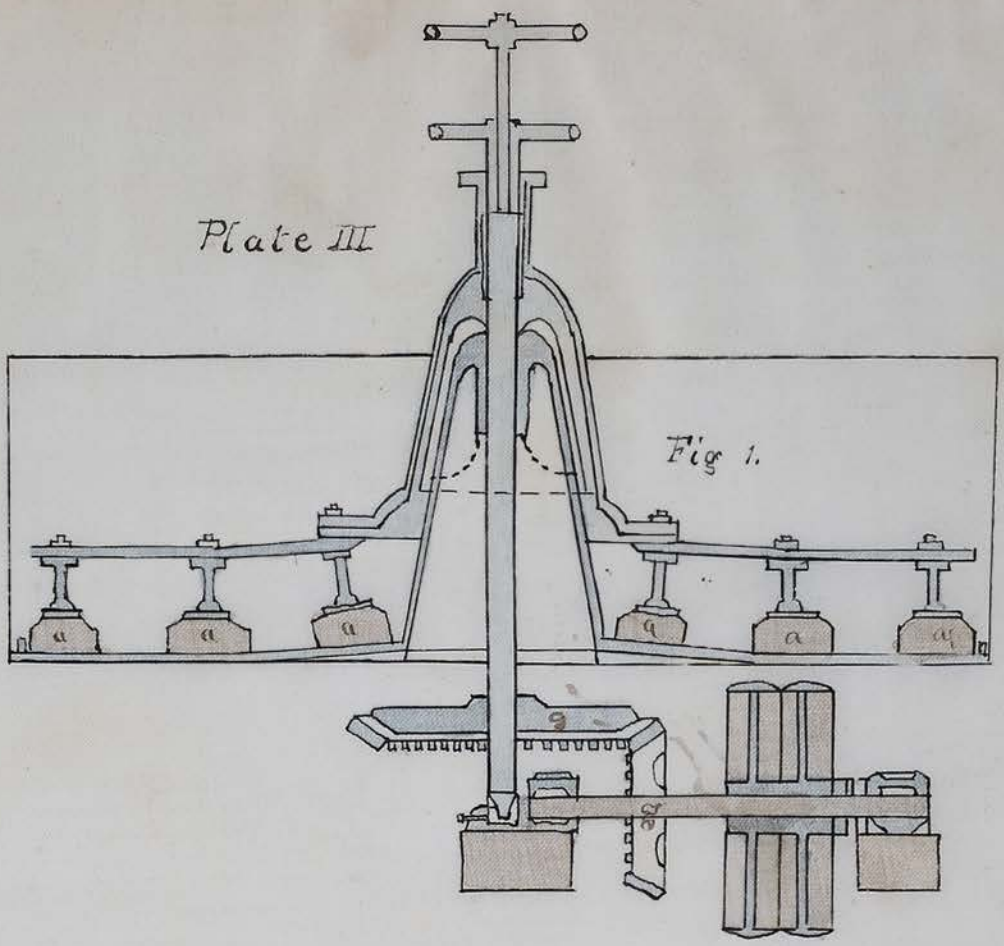


Fig. 2.

Plate III



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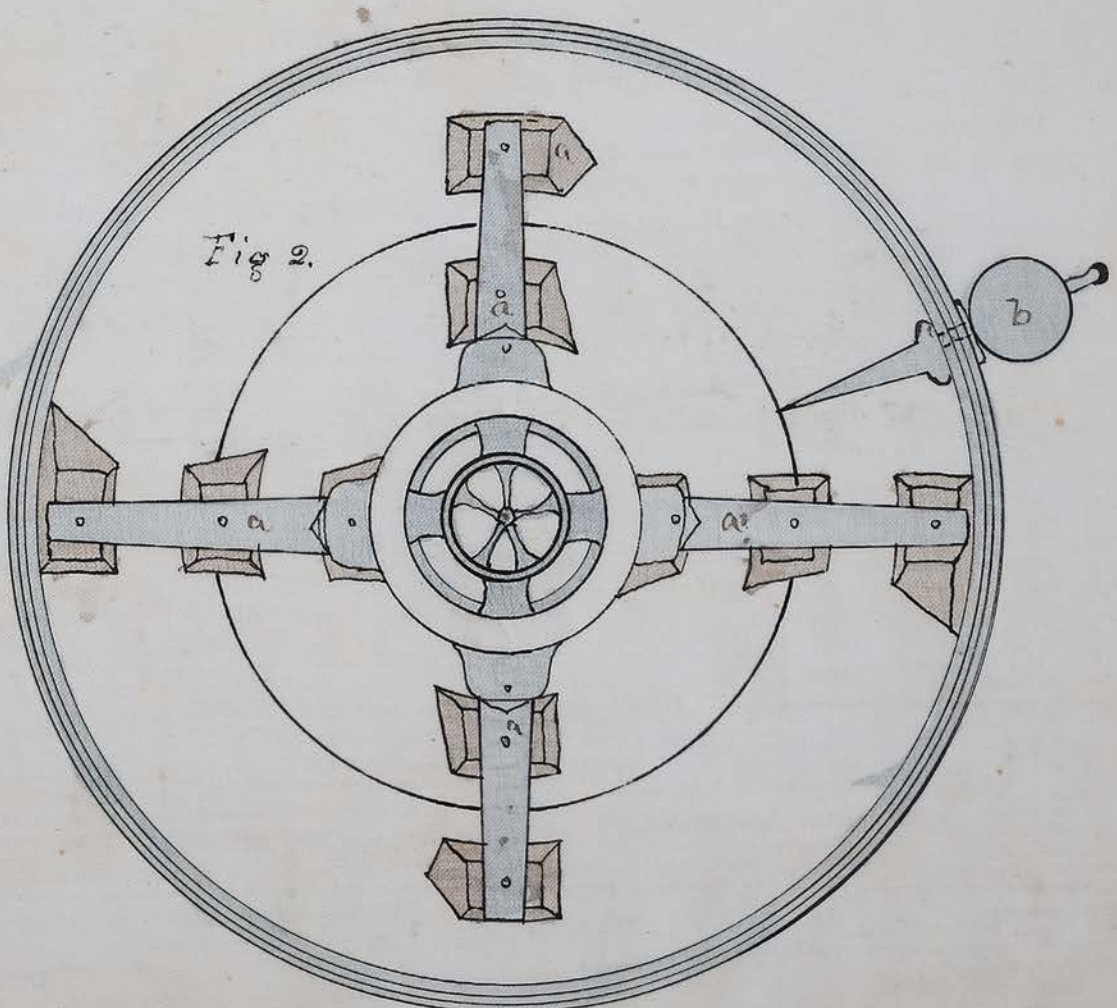
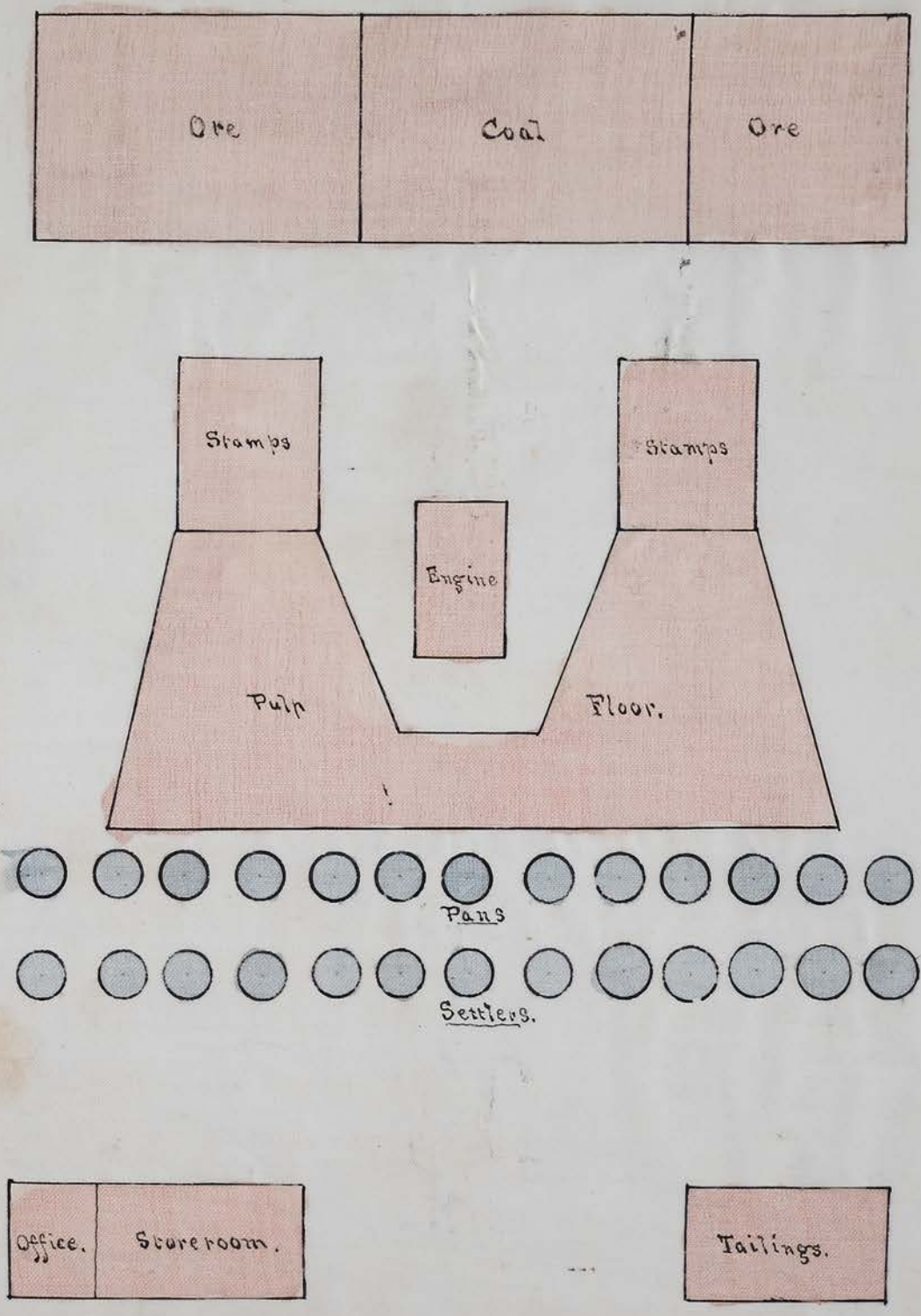


Fig 2.

Plate IV.



Plan of Works.