FILTER-PRESSING.

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Filter pressing, as applied to the treatment of slimes by the cyanide process, aims at a separation, as complete as possible, of the gold bearing solution from solid matter by filtration under pressure, giving clear solutions, and leaving the residue in a sufficiently dry state to allow of transportation in trucks or otherwise to the residue dump.

The removal of the last traces of gold-bearing solution from the solid cakes is effected by forcing a wash solution free from gold through them, in most cases followed by a draught of air which dries the cakes as completely as possible

The filter press may be briefly described as follows:—

The ordinary press as used on the Kalgoorlie field is the No 17 Dehne and Harzer, having a capacity of 117 cubic feet, or about 4·8 tons of dry slime for material of average specific gravity, and a filtering surface of 950 square feet. It consists of 50 hollow or "mud" frames 3 inches deep and 40 inches square (outside measurement), and 49 solid or "filter" plates about $1\frac{1}{4}$ inches thick and 40 inches square. The hollow frames alternate with the solid plates thus forming 50 closed chambers, each about 36 by 36 by 3 inches. Presses forming cakes 2 inches and $1\frac{1}{4}$ inches are also in use, but only for special reasons, as for instance, when treating impervious clayey material, thick cakes of which cannot well be formed, the size of the frames and plates also varies from less than 40 inches up to 60 inches, but this again only in special cases. Each plate and frame in a press is provided with lugs through which holes are bored, forming continuous channels when the plates and frames are clamped together, through which the slime enters the press, and solutions enter and leave it. Around the channels in the plates, grooves are cut about $\frac{1}{4}$ inch deep into which are fitted indiarubber rings making tight joints between them and the frames. To further prevent leakage, and to lessen the wear on the filter cloths which are stretched over them, strips of baize or blanket about $1\frac{1}{2}$ inches wide are fixed, with "P and B" paint around the plates on both sides; this is known as "packing."

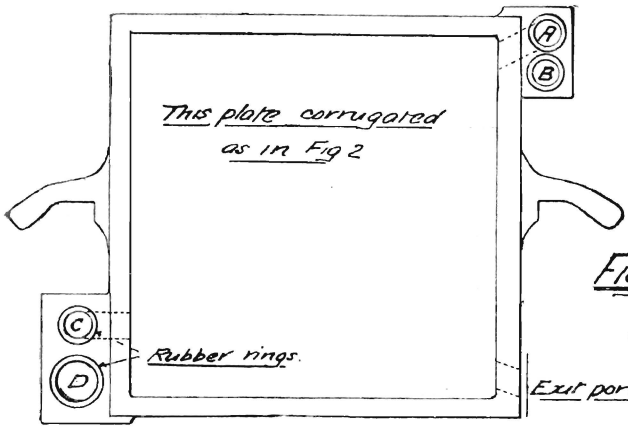
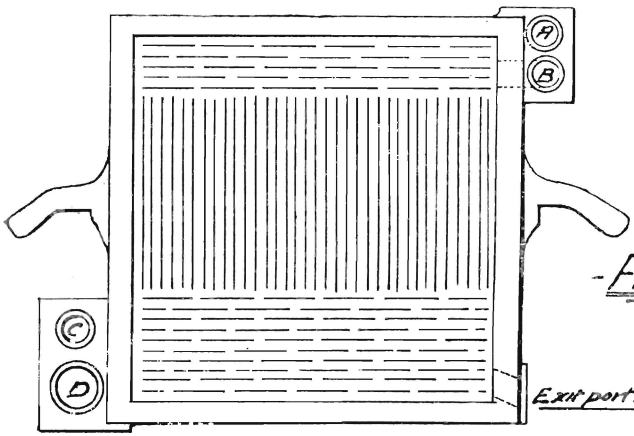


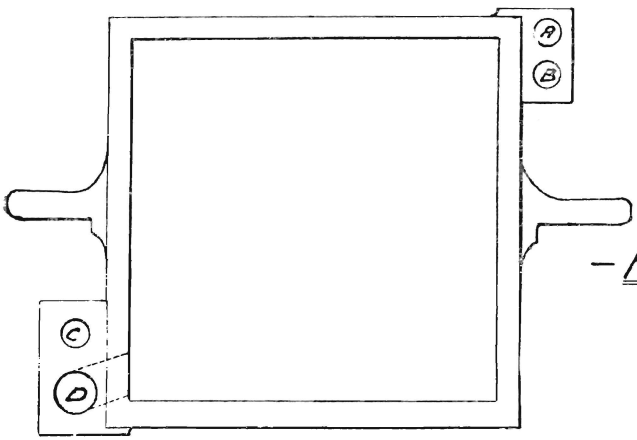
Figure 1.-

High Pressure Plate.



-Figure 2.-

Low Pressure Plate.



-Figure 3.-

Mud Frame.

The press is fitted with four channels (see figures 1, 2, 3, and 4)—there may be more for special purposes; *a*, is to allow the air to escape from the press and communicates only with every alternate solid or 'High Pressure' plate; *b*, is the wash solution exit channel and communicates with the other solid or 'low pressure' plate; *c*, is the wash entrance channel, and communicates with the high pressure plates; *d*, is the sludge channel, and communicates with the hollow frames only.

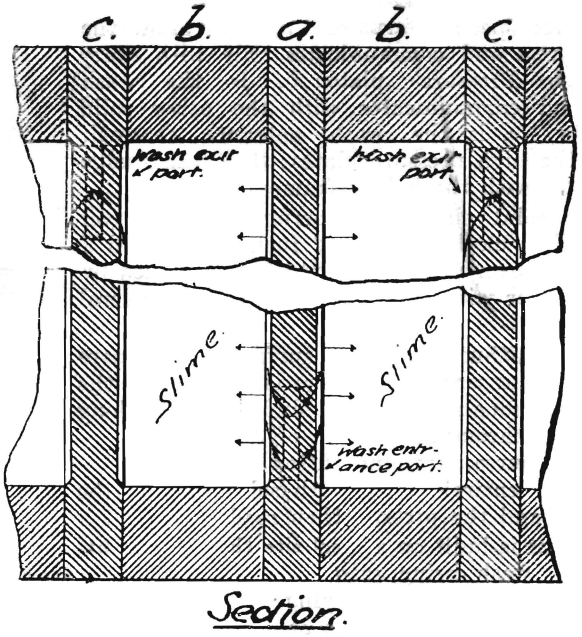
The surfaces of the solid plates are corrugated, and over them are stretched the filter cloths, about 42 inches wide and 7 feet long, which are doubled over the plate at the top and fixed by sewing the two edges together with string or thin wire at several places around the plate.

The hollow frames have thus a filtering surface of 9 square feet on each side of them, and when the sludge is forced into the frame the solution passes through the cloths, finds its way along the corrugations and passes through ports out of the press by means of taps which, of course, are only fitted to the 'solids.' Finally, the frames become entirely filled with solid matter, the supply of sludge is cut off and the press is then ready to wash.

In cases where the plant is built on a level site thus necessitating the gold solution and wash being raised above the level of the press to allow of gravitation to the clarifying press, zinc boxes, etc., the press is provided with two channels at the bottom right hand side, and the taps are done away with. One of these channels, the wash channel, joins up all the low pressure parts, and the other the high pressure parts, the solutions, leaving the press can thus be forced to any height required. These channels are, of course, provided with valves to enable them to be opened or closed when necessary.

WASHING.—In washing the press the solution is forced along the wash channel (*c*, fig. 1. 2, and 3), enters behind the cloths on the high pressure plates by the ports provided, passes through the cloth, the cake next to it, and the cloth on the other side of the cake, and passes out through the ports and taps of the low pressure plates. This is called the 'side' wash or thorough extraction system. Fig. 4 shows the course of the wash.

Another method is to 'centre' wash, by forcing the wash through the sludge channel and into the cakes that way. This short description of the press may be concluded by saying that the plates and frames slide on a steel bar about 3 inches diameter, at each side, supported at each end by the main standards and also by two, or sometimes three intermediate standards on each side. These bars are provided with threads for about three feet of their length at one end, on which the capstan nuts are screwed, which tighten up the press. When emptying the press these nuts are run back for about two feet, and then each frame and plate pulled back, the frames tilted and the cakes dropped out. When all the frames are empty, they, with the plates are pulled back,



Section.

-Fig 4.-

Diagram.

shewing course of wash solution.

a. High Press: Plate.
b. Mud Frame.
c. Low Press: Plate.

two or four at a time, to the fixed head piece of the press, the capstan nuts run up and tightened by levers, and the final pressure brought to bear by means of the angle levers and wheel, said to give a mechanical advantage of 1500·1. The press is then again ready to fill.

The head or end piece of the press is, of course, made very strong by means of deep ribs cast on the back of it; these act as stiffeners to prevent any giving or bending under the pressure of, say, 80lbs. per square inch, which would result in the breakage of plates and frames.

A No. 17 press weighs about 25 tons, and is wholly of cast iron except the few parts which are subject to tension

Plant Required.—In the case of the big mines of Kalgoorlie the whole of the ore is treated by filter-pressing, being first crushed through about 30 mesh screens by ball mills, griffin mills, stamps, etc., then roasted in some form of mechanical reverberatory furnace, separation effected by spitzkasten, and the coarse material ground and re-ground to slime in grinding pans or tube mills. In the 'Diehl' process the roast is omitted, the raw ore being slimed as before so that 95 to 98 per cent. passes a 150 mesh.

For the sake of illustrating the filter press process, however, it will be sufficient to take the case of a plant to re-treat an old dump in which the material is already slimed. Assuming that the presses are to be filled by means of a plunger pump (this will

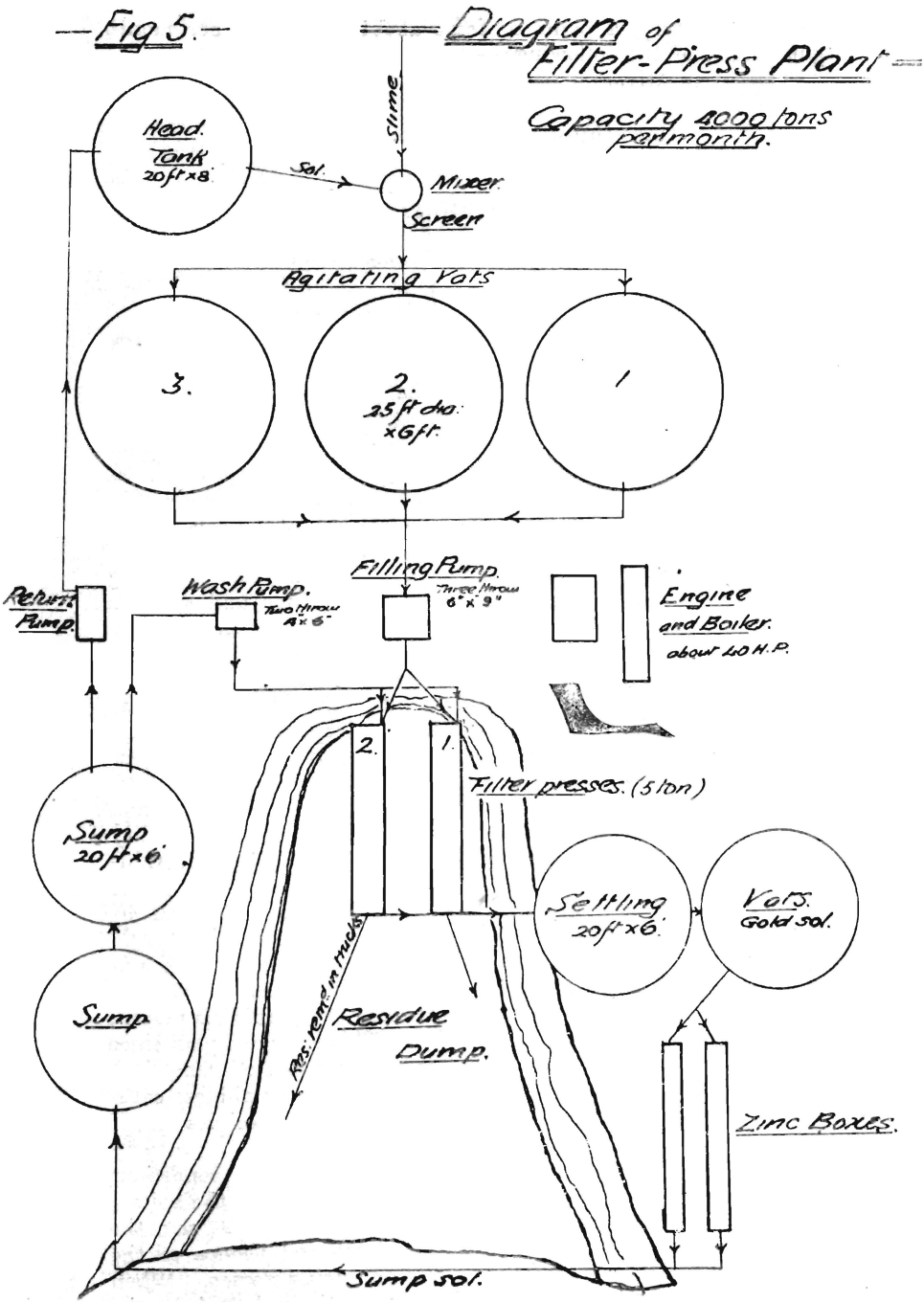


Fig 5.
Diagram of Filter-Press Plant
Capacity 4000 tons per month.
Head Tank 20ft x 8
Sol.
Slime
Mixer
Screen
Agitating Vats
3.
2. 25ft dia. x 6ft.
1
Filling Pump
Three Throw 6" x 9"
Wash Pump.
Two Throw 4" x 6"
Return Pump.
Engine and Boiler.
about 40 H.P.
2.
1.
Filter presses. (5 ton)
Sump 20ft x 6
Sump
Settling 20ft x 6.
Vats. Gold sol.
Res: rem'd in trucks
Residue Dump.
Zinc Boxes.
Sump sol.

be discussed later), a plant to treat about 4000 tons per month might consist of the following:—

A Mixer.
3 agitating vats.
1 three-throw filling pump.
1 three-throw wash pump.
2 five-ton presses.
Clarifying press or settlers.
Zinc boxes.
Head and sump solution tanks.
Return pump from sump to head tank.
Engine and boiler or electro-motor.
Also trucks or belt conveyer for removal of residues.
(See fig. 5 for diagram of plant.)

The following is a description of the process.

The dry slime to be treated is carted or trucked to the mixer. This consists of a cylindrical steel vessel, say, 4ft. 6in. diameter and 6ft. deep, having a perforated steel cone with the apex cut off so as to leave an opening about 2ft. diameter inside it; below this cone is a propeller on a vertical shaft which is driven at, say, 150-200 revolutions per minute. Sump solution from the head tank is run into the mixer, and the slime dumped in. The revolving propeller breaks up the lumps and mixes the slime and solution to form a uniform pulp, which by centrifugal force is thrown outwards and upwards and escapes over a lip at the top of the mixer. After passing through a coarse screen to remove any chips of wood, etc., the pulp flows through launders into the agitating vats which may be 25 feet diameter and 6 feet deep, where it is kept agitated and in a favourable state for the cyanide to act on it, by means of arms revolving at the rate of about 15 revolutions per minute. The practice of agitating by means of centrifugal pumps is not a good one, there is a great waste of power, and reliability is essential, since, if the agitation is stopped for any considerable time the slime settles and the vat has to be dug out. The power to agitate pulp of ordinary consistency in a 20ft. x 6ft. vat by means of revolving arms does not exceed 1.5-horse power.

The cyanide required may be added in solution to each agitator charge, or it may be dissolved by the solution as it runs into the mixer by interposing a small box in which the cyanide is placed, in the pipe line at some convenient point. This is a good plan since the cyanide gets to work in the mixer without loss of time, and there is less chance for the formation of alkaline sulphides, causing decomposition of cyanide, and in some cases re-precipitation of gold.

After sufficient agitation (the time under difficult conditions may vary from 6 to 18 hours), the pulp is drawn out of the agitating vats by the filling pump and forced into press No. 1, say, the solution going either to the zinc boxes direct and thence to the sump, or first through a clarifying press or setting device. When the press is full, the wash solution is pumped through it from the

sump, after which it is ready to open and empty. The solid residue is dropped into trucks or onto a belt conveyor beneath the press floor and conveyed to the dump. While press No. 1 is filling and washing, No. 2 is being emptied and closed up to be ready to fill again when No. 1 is ready to drop.

There are two methods of filling and washing presses.

(A) By means of compressed air.

(B) By direct pumping.

(A) In this system the sludge is run into a large receiver called a "monteju," which should hold enough sludge to fill a press. Compressed air is admitted, forcing the sludge through a pipe into the press. In general the pipe carrying the air passes nearly to the bottom of the monteju, so as to keep the sludge agitated during the time the press is filling. As the press fills, the pressure as shown by the gauge on the monteju rises, until the maximum of say 65lbs. per square inch is reached, when the press is full. Washing is performed in a similar manner.

ADVANTAGES OF USING AIR.—(i.) There is no danger of the pressure becoming excessive as may happen with a pump. The air receiver is furnished with a safety valve blowing off at, say 60lb., so there is no possibility of the pressure going any higher.

(ii.) The cakes can be dried better, which is important where water is scarce, and which also ensures less gold being left in the residue, and gives a better product for handling by belt conveyor.

(iii.) Where channels instead of taps are provided for exit solutions, air must be used to blow the pipes and channels clear.

DISADVANTAGES.—(i.) High cost both of plant and power. In cases where the montejus do not hold enough sludge to fill a press (and very often this is the case), there is a great waste of power as the air has to be released and the monteju refilled. When this is the case it is more economical to blow a little sludge into the press and then refill. The amount of sludge to fill a press varies of course with the consistency of same, and this is a rather nice question, thick pulp taking less handling and agitator space, etc., but generally having a bad effect on the extraction. Obtaining thick pulp also necessitates the use of settling or thickening arrangements subsequent to fine grinding, since grinding pans can only do good work on thin pulp.

ii.) Generally the same pressure must be used for washing as for filling, whereas it is advantageous to wash at a higher pressure, not only because a greater volume of wash can be passed in a given time, but because the washing is likely to be more thorough, the solution having a better chance of penetrating all parts of the cake equally.

METHOD OF FILLING THE PRESS.—This has been for the most part described above. When the press is being filled the amount of solution coming from the taps decreases and the pressure rises, the taps finally only dripping, and the pressure reaching the maximum when full. During filling, the air is throttled, so that the pressure rises gradually, otherwise there would be considerable leakage and