Feb. 13, 1962 G. H. JONES 3,021,007

IMPROVEMENTS IN MEANS FOR MAGNETICALLY SEPARATING SOLID MAGNETIC PARTICLES FROM A FLUID CURRENT

Filed Jan. 15, 1960

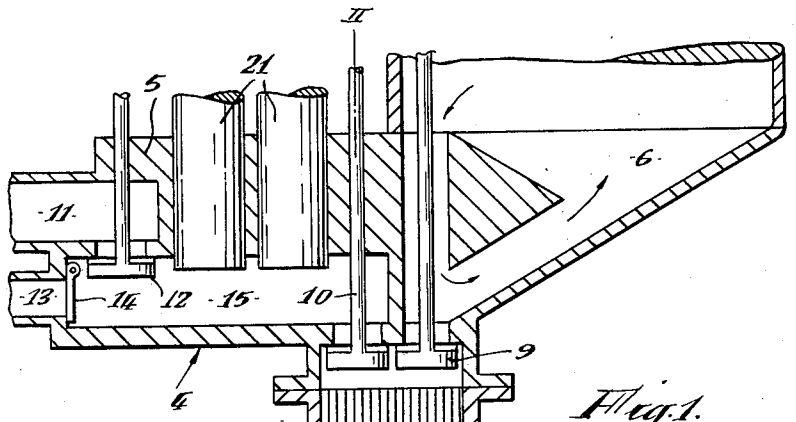


Fig. 1.

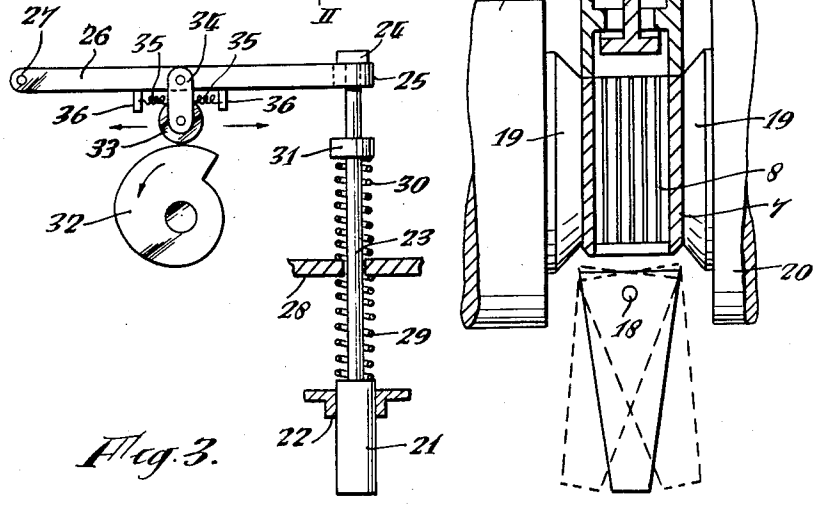


Fig. 3.

Fig. 2.

Inventor:
George Henry Jones
by Robert Henderson
Attorney

United States Patent Office 3,021,007 Patented Feb. 13, 1962

3,021,007

IMPROVEMENTS IN MEANS FOR MAGNETICALLY SEPARATING SOLID MAGNETIC PARTICLES FROM A FLUID CURRENT

George Henry Jones, Sea View, Connor Downs, Hayle, Cornwall, England, assignor of fifty-one percent to William John Dennis Stone, Ottawa, Ontario, Canada

Filed Jan. 15, 1960, Ser. No. 2,742
Claims priority, application Great Britain Jan. 28, 1959
4 Claims. (Cl. 209—223)

This invention relates to means for magnetically separating solid magnetic particles from a fluid current of the kind wherein a fluid current feed comprising solid particles in a stream of fluid which is passed between grooved plates situated in a magnetic field, for a short period i.e. the feed period. Magnetic particles in the feed are attracted to the grooved plates and after a predetermined period the feed is then cut off by closing a feed valve control and a gentle stream of washing water is allowed to pass by the opening of a wash water valve. The magnetic particles adhering to the grooved plates are thus washed reasonably clean; but left adhering to the plates, this period is known as the washing period.

The wash water valve is then closed, and a scouring water valve is opened to admit water at a higher pressure known as scouring water, which washes the magnetic particles off the plates.

The three periods of feed, washing and scouring are said to comprise one normal cycle. The fluid leaving the grooved plates is deflected by a tilting funnel arrangement into three launders or containers, for non-magnetic particles, washings and magnetic particles respectively during the respective periods of feed, washing and scouring.

According to the present invention, in order to make the washing more effective especially in removing non-metallic particles trapped between magnetic ones, means for separating solid particles from a fluid current as described impart one or more severe pulses of short duration in the flow of wash-water supply.

The pulsating action may be achieved, for example, by the use of one or more cylinders and rams, arrangements provided at a suitable place in the wash-water supply. During the washing period, a ram is caused to operate, resulting in a momentary large increase in the flow of wash-water sufficient to dislodge a large proportion of the magnetic particles adhering to the plates. As the disturbance in the flow of wash water is only of very short duration, the magnetic particles are recollected on the plates, whereas non-magnetic particles liberated by the pulsing are carried off in the wash-water. The pulsing may be repeated as many times as practicable, more than one ram being used if necessary either simultaneously or consecutively.

The ram or rams may be similarly operated during the scouring period, if desired, to make scouring more effective.

The ram or rams may be operated mechanically for example a cam may lift the ram against a spring. The ram is released by the cam at the appropriate moment to initiate a quick fall, due to the force exerted by the spring so that there is a sudden surge of water past the open wash water valve.

Alternatively the ram or rams may be operated by other suitable means, e.g. by solenoids, hydraulically, or by compressed air. A diaphragm may be used in place of a ram or other means may be employed to cause pulsing or vibration in the water column.

In order that the invention may be clearly understood and readily carried into effect, reference is directed to the accompanying drawings, wherein:

FIGURE 1 illustrates diagrammatically in sectional side elevation apparatus for magnetically separating solid magnetic particles from a fluid current.

FIGURE 2 is a section partly in elevation on the line II—II, FIGURE 1.

FIGURE 3 shows in side elevation to a slightly smaller scale a ram and operating mechanism therefor according to the invention.

Referring to the drawings and FIGURES 1 and 2 in particular, **4** indicates a main body structure of an apparatus for magnetically separating solid magnetic particles from a fluid current and comprising fluid control unit **5** feed hopper **6** and collector plate box **7**, the latter housing grooved collector plates **8**. The fluid material to be treated issues from the feed hopper **6** by way of feed valve **9** and scouring and washing water from the fluid control unit **5** flows through the collector plate box **7** under the control of a combined wash and scouring valve **10**, scouring water being supplied through an inlet **11** and controlled by a scour valve **12** and wash water entering through an inlet **13** and passing a non-return valve **14**. The fluid control unit **5** has a common chamber **15** to which the valves **12** and **14** open and the valve **10** provides an exit therefrom. The fluid current passing through the apparatus after flowing over the grooved collector plates **8** enters a funnel **16** which is rockable on a pivot arm **18** to divert the fluid current as shown in dotted lines in FIGURE 2. FIGURE 2 illustrates the means for creating a magnetic field transversely of the grooved plates **8**, the field being provided between the pole pieces **19** of electromagnets **20**. The foregoing arrangement complies with the apparatus of the kind hereinbefore disclosed and the present invention is directed to the provision of one or more rams **21** which have a bearing in the wall of the main body structure **4** to extend into the chamber **15**, operation of the rams creating a pulsating movement in the body of water within the aforesaid chamber. The non-return valve **14** prevents the higher pressure scouring water passing back to the wash water supply.

FIGURE 3 illustrates one suitable means for actuating a ram; the outer end of a ram **21** extends through a stuffing box **22** and is provided with a stem **23** terminating in a collar **24** which engages the hooked end **25** of a rocker **26** pivoted as at **27**. The stem **23** extends freely through an abutment plate **28**, a main spring **29** encircling the stem below the abutment plate **28** and a re-bound spring **30** embracing the stem **23** above the said abutment plate and against a stop **31**. The rocker **26** is raised and allowed to fall abruptly by means of a cam **32** which engages a roller **33** pivotally supported from the rocker **26** by a pair of links **34** swinging movement of the links being against spring loading applied by springs **35** abutting stops **36**. This described ram-actuating means, it will be seen, is in the nature of a so-called "load and fire" arrangement.

During operation of the apparatus and whilst the washing period is being conducted, the scour valve **12** and the feed valve **9** to the plate box **7** are closed, valve **10** to the plate box **7** is open so that wash water passes through the non-return valve **14** and the plate box **7**. The ram or rams **21** are lifted by the cam **32** against their spring loading **29**. When required and at a suitable point during the washing period, the ram or rams **21** are released, preferably consecutively if there is more than one ram. The rams fall quickly due to the force exerted by the spring **29** so that there is a sudden surge of wash-water past the wash and scour valve **10**. The wash-water inlet supply pipe **13** should be of such proportions and dimensions that an appropriate proportion of the surge passes through the valve **10** rather than against the wash water supply, the non-return valve serving to some extent as a stop to such movement.

The effectiveness of scouring i.e. when valve **12** is open may also be increased if the ram or rams **21** are lifted prior to scouring and forced down quickly during the scouring period, so that the velocity of the fluid through the plates is momentarily increased.

In order to obtain a more rapid pulse of smaller amplitude than that obtained by the method previously described, a spring loaded hammer is adapted to be raised by a cam and rocker, or other suitable means, against its spring, so that when released, the hammer is accelerated by the spring to the required velocity, and then strikes a ram importing a rapid pulse of compartively small amplitude to the fluid "beneath" the ram.

What I claim and desire to secure by Letters Patent is:

1. Apparatus for separating solid magnetic particles from liquid, comprising, in combination, a collector-plate box, a collector plate mounted in said box, means for introducing liquid to be treated into said box and about said plate, means for creating a magnetic field in the vicinity of said plate to cause solid particles in said liquid to adhere to said plate, means for carrying-off treated liquid from said box, liquid-conducting means for introducing a flow of washing liquid through said box and about said plate, and agitating means operatively connected to said liquid-conducting means and adapted to impart, to liquid in said box, a severe pulse of short

duration, to dislodge solid particles from said plate; said magnetic-field-creating means operating, at the end of said pulse, to cause such solid particles, of a magnetic character, to re-adhere to said plate, leaving non-magnetic particles free to be carried off with liquid passing from said box.

2. The combination according to claim 1, wherein said liquid-conducting means also include means for introducing a flow of scouring liquid through said box and about said plate, and said combination further comprises valve means, associated with said liquid-conducting means, for so controlling the flow of the washing liquid and the scouring liquid as to introduce them separately into said box and about said plate.

3. The combination according to claim 1, wherein said agitating means comprise a ram in pulse-imparting association with said liquid-conducting means.

4. The combination according to claim 3, further comprising a load and fire mechanism, operatively connected to said ram, to cause rapid operation of the latter.

References Cited in the file of this patent

UNITED STATES PATENTS

1,354,604	Duggan	Oct. 5, 1920
2,338,418	Forrest et al.	Jan. 4, 1944
2,398,725	Schutte	Apr. 16, 1946