Sept. 4, 1928. 1,682,820

P. WOLF

WASHING APPARATUS FOR COALS

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Fig. 1

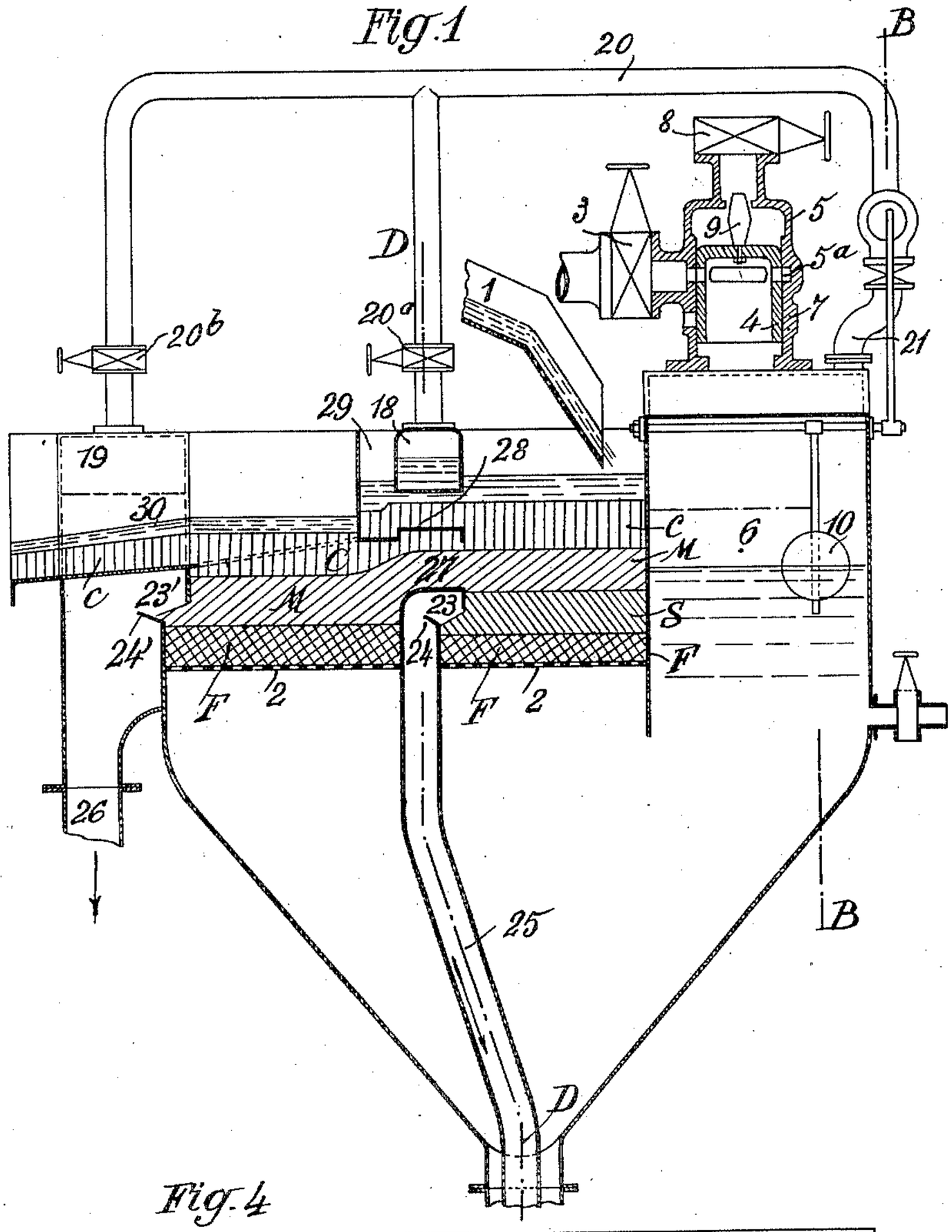
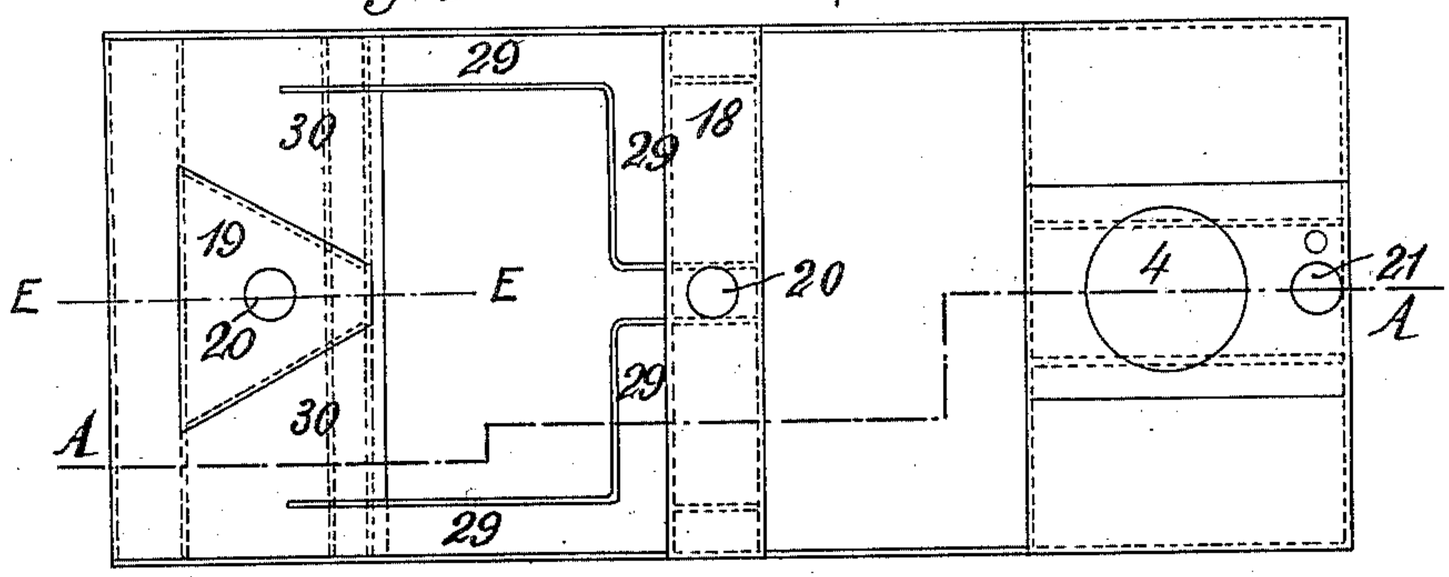


Fig. 4



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WASHING APPARATUS FOR COALS

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Fig. 2

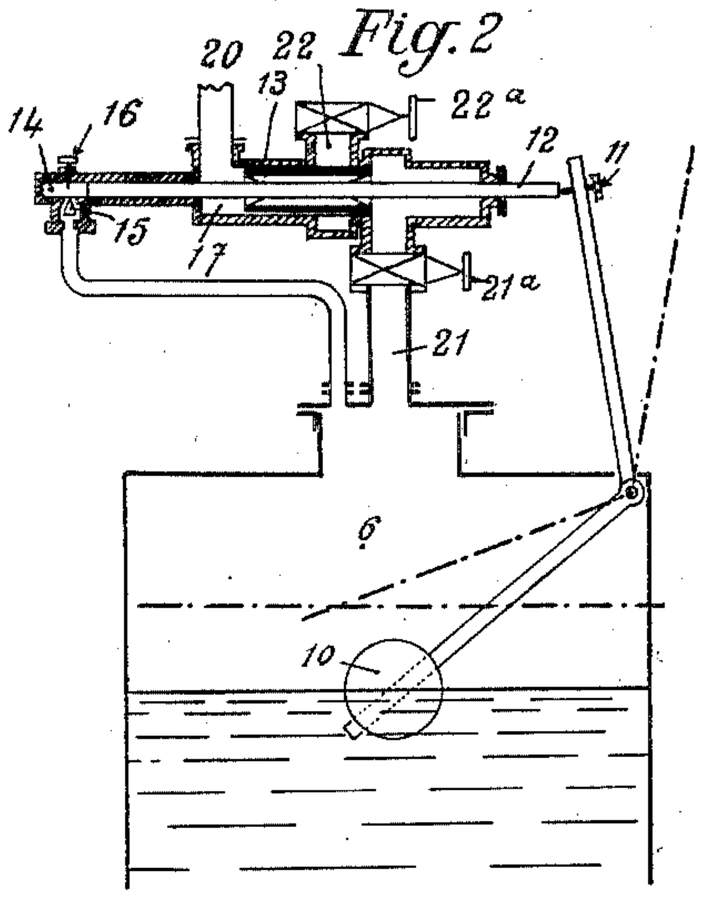


Fig. 3

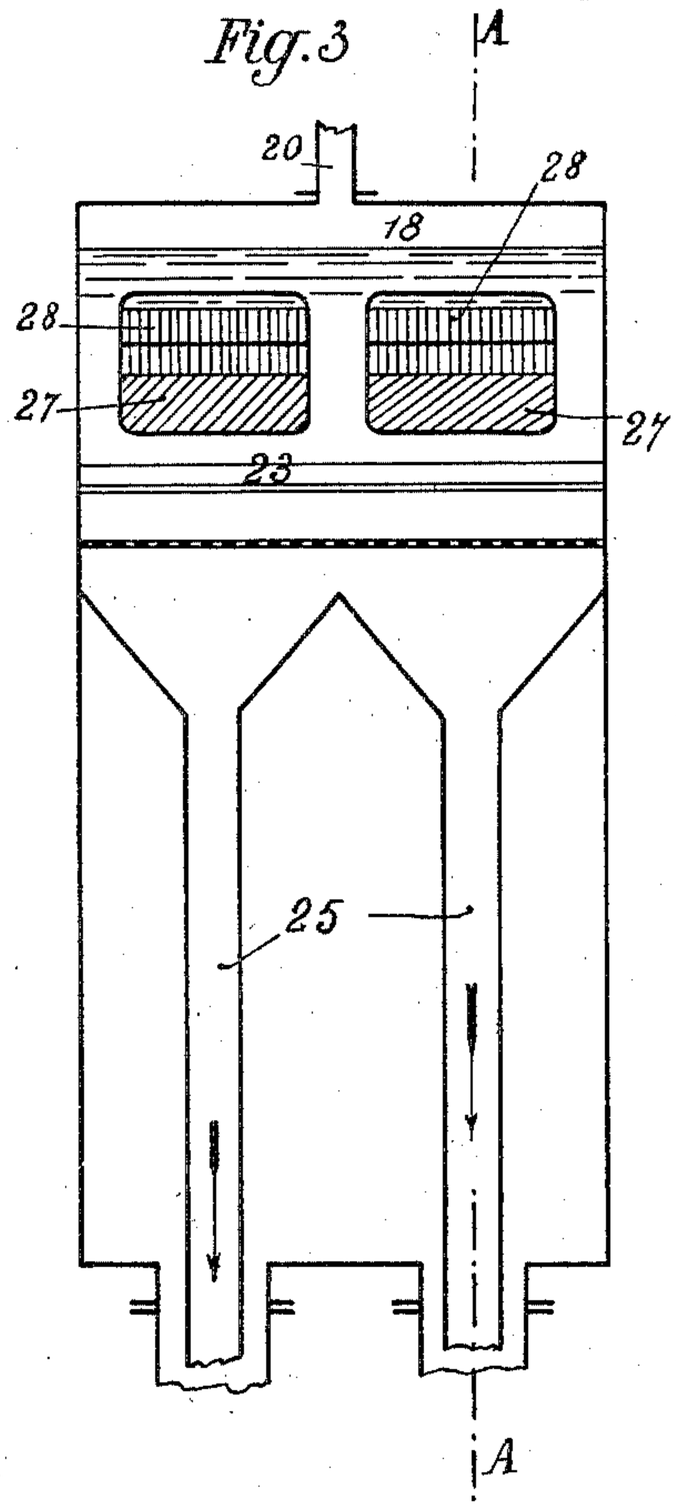
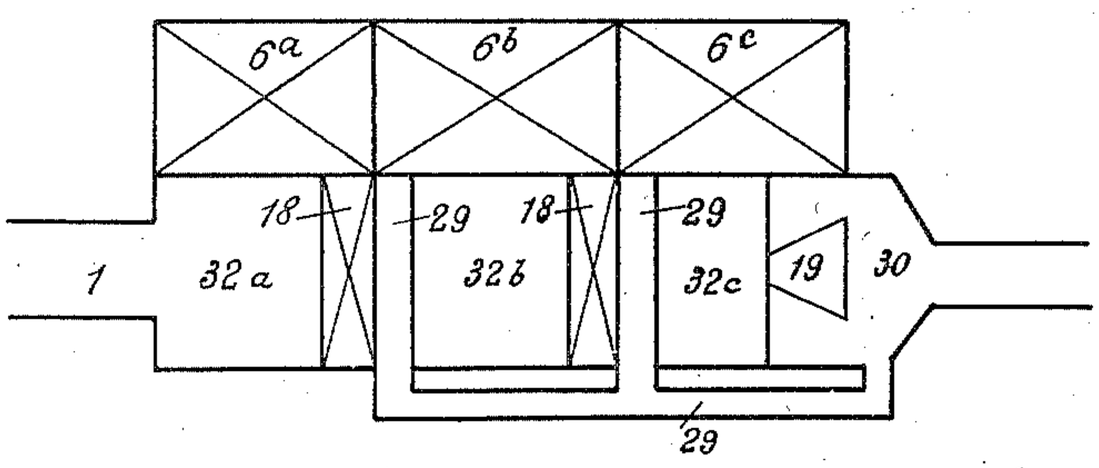


Fig. 5



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Filed Oct. 22, 1923 3 Sheets-Sheet 3

Fig. 7

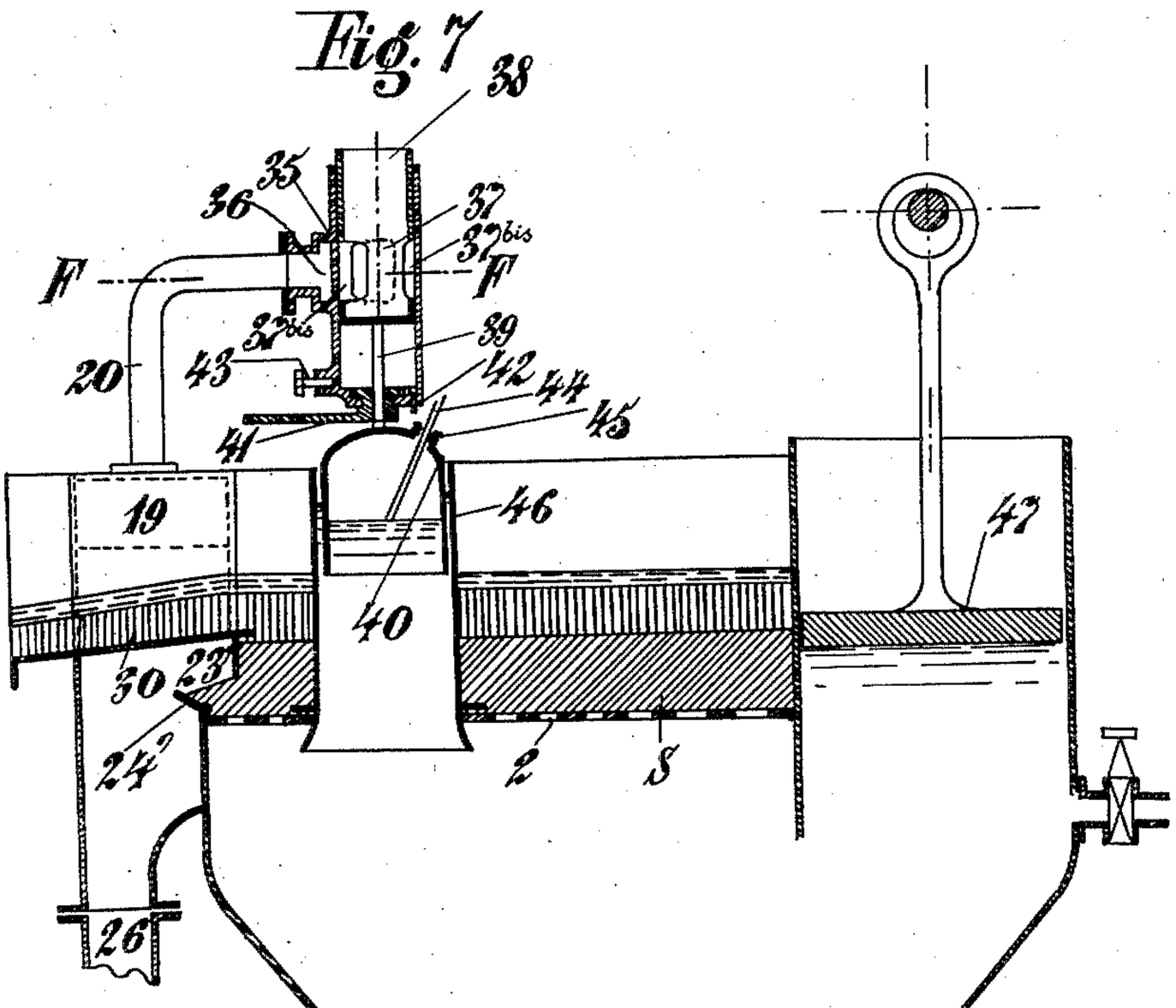


Fig. 8

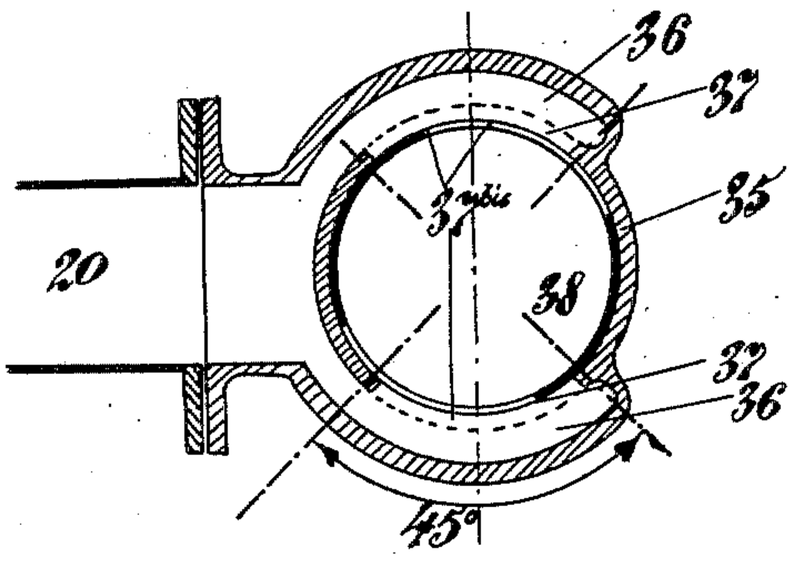
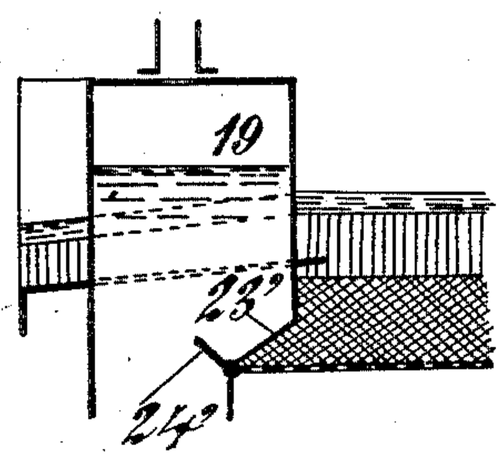


Fig. 6



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Patented Sept. 4, 1928. 1,682,820

UNITED STATES PATENT OFFICE.

PHILIPPE WOLF, OF PARIS, FRANCE.

WASHING APPARATUS FOR COALS.

Application filed October 22, 1923, Serial No. 670,055, and in France October 24, 1922.

This invention relates to apparatus for washing coals with pneumatic pistons of the same type as those which regulate the separation of the products, without any immersed mechanism, and of the same type as those which utilize the thickness of the layer to be washed for the purpose of producing automatically the regulation of the discharge of the heavy products.

Washing vats with pneumatic pistons are known. In the washing vat which forms the subject matter of this invention, the system of pistons is independent of any mechanical drive and the frequency of the pulsation is instantly adjustable by actuating a valve.

Washing vats are also known in which the control of the separation of the products is effected without the intervention of valves immersed in water by manually regulating cocks controlling the escape of air.

In the washing vat, which forms the subject matter of this invention, the regulation of the apparatus is automatic, whereby all supervision is done away with, the apparatus regulating itself according to the percentage of heavy products in the substance to be washed, and the quantity of said substance reaching the vat.

Apparatus which produce automatic regulation by means of mechanisms immersed in the water and the products to be evacuated and acting under conditions of defective mechanical working and under the risk of being jammed, are also known. In the apparatus, which forms the subject matter of this invention, all mechanical parts are positioned in the air under the best working conditions and without any possibility of jamming.

Another distinguishing feature of this washing apparatus lies in the simultaneous evacuation of the lightest and the heaviest products at the level of the evacuation compartment of the heavier products.

In the accompanying drawings given by way of example:

Fig. 1 represents in longitudinal section a piston vat with a pnuematic piston system for washing coals which separates the material treated into three products, the section being taken through the axis of the pnuematic piston system (section line A—A, Fig. 4).

Fig. 2 is a transverse section passing through the axis of the regulating apparatus for the evacuation of dirty products (section line B—B, Fig. 1).

Fig. 3 is a transverse section on line D—D of Fig. 1

Fig. 4 is a plan view of the piston vat.

Fig. 5 shows in plan an arrangement consisting of several washing apparatus in series.

Fig. 6 is a sectional detail view taken on a vertical plane thru a discharge chamber of the apparatus.

Fig. 7 represents the longitudinal section through the axis of a washing vat with mechanical piston system which separates the crude coals treated into two products.

Fig. 8 is a section along F—F, Fig. 7.

The substances to be washed arrive through a chute 1 in the washing vat at one of the extremities of the washing bed which consists of a perforated sheet-iron plate 2. The substances are then shifted towards the other extremity, whilst becoming classified in the order of their densities, S, M and C indicating respectively the layers of slates, mixed substances and coals.

Towards the centre of the washing bed is provided a device which permits the discharge of the slates, and the lightest products, the mixed substances and the coals, not yet separated, being separated at the end of the apparatus.

The discharging sill for the lightest products designated by 28 is located at the center of passages 27 which extend thru a closed chamber 18. This chamber communicates thru an orifice 23 with the washing vat and an adjustable shutter 24, the inclination of which can be varied according to the working conditions, is provided at said orifice. The chamber is extended downwards by means of conduits 25 thru which the slates are adapted to be discharged (see particularly Figs. 1 and 3).

At the extremity of the washing bed, opposite the point where the products to be washed arrive, is arranged a closed chamber 19 for the evacuation of the mixed substances similar to the chamber 18 which also communicates through an orifice 23′ with the washing vat and extends downwards through a tube 26 for the evacuation of the mixed substances and forms in its upper part a compression compartment (Fig. 6).

The aforesaid portion of the passages 27 which is located above the sill 28 communicates through lateral passages 29 with the sill 30 for the evacuation of coals or the lightest products.

The washing vat communicates with a pneumatic piston compartment 6 (Fig 1), over which is mounted the apparatus for the distribution of compressed air which produces the piston work, and the controlling device for the evacuation of the dirty products which device communicates through pipes 20 with the compression compartment of the aforesaid chambers 18 and 19 for the discharge of slates and mixed substances.

The piston operation is pneumatic. Compressed air is conducted thru a valve 3 into a distributing chamber comprising a cylinder 5 in which reciprocates a piston valve 4. In the position shown in Fig. 1 the piston valve 4 is in admission position. The air passes thru orifices 5^a distributed around the circumference of cylinder 5 and thru corresponding ports in the walls of the piston valve to the chamber 6 in which water is contained forming a part of the piston system. While forcing down the water in said chamber the compressed air also acts upon the piston 4 pushing the latter upwards until it uncovers the escape openings 7. The escape of air thru opening 7 then continues until the pressure of the air in chamber 6 has been sufficiently reduced to cause the water to rise in chamber 6 and the piston valve 4 to fall by gravity and resume its admission position.

The amplitude of the piston range is regulated by means of the valve 3 by the pressure of the compressed air and the frequency of the piston stroke is regulated by means of a valve 8 which controls the admission of air to and the exhaust of air from the upper part of the cylinder 5.

It is also possible to regulate for each of its positions the speed of the piston valve 4, this being done by means of rod 9 carried by said piston valve 4 and formed with a suitable profile, so that the section for the passage of the compressed or sucked up air above the drawer may be determined in any position of the latter.

The washing is effected as in a washing box with normal pneumatic pistons. Let us consider the working of the chamber 18 for the discharge of the slates, the working of the chamber 19 being similar. The lightest washed coals are evacuated at each stroke of the piston over the sill 28, whilst the non-separated mixed substances and coals are evacuated through the lower passages 27 and the slates through the opening 23.

The sheet-iron, which forms a grating and limits the aperture 23 at the top, being in front of the shutter 24 which it limits in the lower part, the slates form from the lower edge of said sheet-iron a heap which upon meeting the shutter 24 is incapable of statically running off.

At each stroke of the piston the water driven back by the compressed air outside the piston compartment 6 raises the whole washing bed and rushes through the opening 23 where the resistance is less considerable than on the remainder of the bed, towards the discharge chamber 18 and its compression compartment, whilst raising and carrying away the heap of slates which interferes with its passage up to the chamber 18 the slates discharging through the pipes 25. It will thus be seen that in order to regulate the evacuation of the slates through aperture 23 it is sufficient to regulate the current of water flowing through said aperture.

With the piston stroke, the water passing through the aperture 23 rises in the compression chamber 18, whilst driving back the air contained in said chamber. If said chamber is in communication with the atmosphere there is no resistance to oppose the variation of the water level which will be at a maximum as well as the current in 23 and the quantity of evacuated slates. If on the contrary the communication between the chamber 18, and the atmosphere is cut off, the variation of the water level in the chamber 18 is progressively opposed and consequently the discharge of the slates is diminished. If, into the chamber 18 compressed air is admitted the counter pressure on the water in chamber 18 opposes the rising of the level of the water under the piston stroke whereby the establishment of current in the opening 23 is prevented and the discharge of the slates is completely stopped.

In order to obtain automatic control of the apparatus, it is sufficient to carry out these operations automatically as function of the quantity of slates to be evacuated, that is to say, the thickness of the layer of the heavy products. An arrangement for the automatic regulation has been provided as hereunder described.

In the piston compartment 6 is arranged a float 10 fixed to the extremity of a lever keyed on to a shaft rotating on supports. Said shaft carries another lever provided with an adjusting screw 11. Said lever and the screw 11 during the working of the pistons assume an oscillatory motion, the amplitude of which is a function of the amplitude of the piston strokes in 6. Now as the apparatus has been regulated when started, the frequency of the piston stroke is constant as well as the pressure of the compressed air and therefore the amplitude of the displacement of the water in the piston compartment 6 varies in an inverse ratio to the resistance

opposed by the washing bed to the displacement of the water under the constant influence of the compressed air.

The heavier the washing bed, that is to say, the thicker the bed of heavy products the smaller will be the amplitude of the piston strokes in 6 and of the displacement of the screw 11. On the contrary the lighter the washing bed, that is to say, the thinner the bed of heavy products the greater will be the amplitude of the piston strokes in 6 and of the displacement of the screw 11. The amplitude will be smallest when the bed of slates is so thick that the slates begin to be discharged through the opening 27 with the mixed substances, and the bed of mixed substances so thick that the latter begin to be discharged over the sill 30 with the coals and it will be greatest when the bed of slates is so thin that the mixed substances begin to be discharged below the gratings through the opening 23 with the slates and the bed of mixed substances is so thin that the coals will begin to be discharged under the gratings through the opening 23′ with the mixed substances.

The compression compartment of the chamber 18 communicates through a pipe 20 with the device 17 for regulating the discharge of the slates. This arrangement consists of a cylinder in which is displaced a slide 13 mounted upon a rod 12.

At every stroke of the piston, the rod is driven back by the screw 11 up to the left hand limit of the path of the latter with which it is not rigidly connected. Then the screw 11 leaves it during its movement to the right. If any piston stroke is greater than the previous one, the screw drives the rod 12 farther back; if it is smaller the compressed air acting in the cylinder 14 only at the time of said course end which corresponds to the admission of the compressed air into the piston compartment 6, brings back the rod 12 into contact with the screw 11. The slide 13 is thus at any time in a position which is a function of the amplitude of the piston stroke.

The supply of the compressed air in the cylinder 14 is regulated by means of a valve 15 which retards more or less the admission of the air into said cylinder according to the position of a screw 16 against which it is stopped and which permits the free escape of air from the cylinder 14 when the piston system compartment 6 is open to the atmosphere. The position of the screw 16 is adjusted in a suitable manner, care being taken in the first place that the rod 12 does not come in contact with the screw 11 before the latter has reached the limit of its displacement to the left, and secondly that the action of the compressed air is not exercised after the displacement in the opposite direction of said screw 11, the result of which would be to cause the rod 12 to be displaced after the screw 11. Such adjustment is made so that the displacement of the rod 12 should be in all cases very small for each supply of compressed air, that is to say, for each pulsation, so as to avoid irregular motions of the rod 12 and give the certainty of adjustment within a few millimeters, if the rod 12 should follow the screw 11 nothwithstanding the precautions taken.

In the event of the screw 11 passing suddenly from a great amplitude to a small one, the rod 12 would only catch it up after a few pulsations and this has no disadvantage.

The amplitude of the pulsation of the water in 6 varies in inverse ratio to the weight of the washing bed as above stated.

When the quantity of slates to be evacuated is at a maximum the amplitude of the displacement of the float 10 and of the screw 11 is at a minimum and the slide 13 is in its right hand position, opening the aperture 22 for communication between the chamber 18 and the atmosphere through the system of pipes 20 and the cylinder 17, which permits the maximum evacuation of slates.

When the quantity of slates to be evacuated diminishes, the amplitude of the piston working in 6 increases, the drawer 13 shifts to the left, progressively closes the orifice 22 and then gradually opens the communication with the pipe system 21 which leads to the piston compartment 6, which at the same time diminishes the evacuation of the slates until it is completely stopped.

As above stated, the chamber of evacuation of the mixed substances 19 operates in the same manner and at the same time as the chamber 18.

The arrangement which ensures the displacement of the slide 13 as function of the amplitude of the piston system is shown by way of example. It may be replaced by any other connection: mechanical, hydraulic, magnetic, etc.

The washing apparatus which is shown in the drawings is intended for the washing of grains, the washing of fines may be effected on felspar.

The apparatus as shown in Fig. 5 may consist of several successive chambers for the evacuation of the heaviest products like at 18 with a corresponding arrangement for the evacuation of the lightest products. In such case sets of washing and piston compartments, successive and independent, are arranged in series in the direction of the progress of the products, the capacities 18 being perpendicular to the direction of said progress and the perforated bottom sheet-irons of the washing compartments being arranged at decreasing levels in the direc-

tion of the progress of the products to be washed, so as to facilitate the passage of the latter from 32^a to 32^b and 32^c through the apertures 27 provided under the sill 28. The apparatus is terminated by a chamber 19 for the evacuation of the mixed substances and by the sill 30 for the evacuation of the coals on to which ends the lateral channel 29 for the evacuation of the lightest products separated by successive sills 28 in combination with the different capacities 18. Each washing and piston compartment consists of an apparatus for regulating the evacuation of the heavy products. In this way the regulating may be made as function of the quantity of slates for the compartment for the evacuation of the slates as function of the quantity of the mixed substances for the compartment for the evacuation of the mixed substances instead of having a regulation function of the sum of the quantities of slates and mixed substances as in the apparatus illustrated in Figs. 1, 2, 3, 4.

The compressed air distributing apparatus 5 feeds a ramified system of pipes which brings the compressed air to each of the piston compartments 6^a, 6^b, 6^c, whilst each branch of said system is provided with a valve allowing the independent regulation of the amplitude of the piston system in each of said compartments.

In an installation of this type and with coals easy to wash, the width of the washing vat would be reduced to the width of the feeding strainer 1 of the coals. Then by utilizing the classification produced in said strainer by the transport, the water and the coarse products, the piston system would only serve to complete said classification and to produce the evacuation of the heavy products as function of the weight of the washing bed, said evacuation being started through lateral openings arranged on each side of the strainer whilst a transverse aperture 23 would terminate said operation and a sill similar to 28 would separate the lightest evacuated products through a strainer such as 29.

The second series of similar apparatus would separate the mixed substances from the remaining coals whilst a transverse arrangement similar to the evacuation chamber 19 would terminate the operations. The diagram of an installation of this description would only differ from that shown in Fig. 5 by the adjunction of lateral apertures for the evacuation of the classified dirty products.

The arrangements above described may be applied to washing vats with mechanical pistons. The piston system is effected by a piston operated by eccentrics or any other mechanism usually employed.

The previous arrangements which do not specifically form part of the piston apparatus are retained and the regulating apparatus for the evacuation of the slates is modified according to Fig. 7 which represents a vat with pistons mechanically operated which separates the products to be washed in coals C and slates S.

The evacuation sill of the coal 30, the aperture for the evacuation of the slates 23' and the compression chamber 19 are retained.

Said compression chamber is connected by the pipe 20 with the cylinder 35 of the regulating device for the evacuation of the slates. The pipe 20 ends at an annular chamber 36 which communicates through two rectangular openings 37 with the interior of the cylinder 35 which opens it to the atmosphere. In said cylinder moves longitudinally a drawer 38 rigidly attached by the rod 39 to the bell 40. The rod 39 carries a keying groove which enables it to slide longitudinally in the piece 41 which forms the regulating hand wheel, but which does not enable it to turn in said piece. The hand wheel 41 can pivot 90° on the cylinder 35 and be fixed in any position in said angle. The drawer also is provided with rectangular openings 37^b of the same size as those of cylinder 35.

When the drawer 38 is at the end of the high course (the case of Fig. 7), the openings of the cylinder and of the drawer correspond longitudinally, which for a particular regulation of the hand wheel 41 represents the maximum of opening. The position of said hand wheel makes it possible to regulate said maximum from the maximum opening which is equal to the sum of the surfaces of the two openings 37 down to nil.

The cylinder 35 is furnished in its upper part with a valve 42 which allows the air to penetrate into the cylinder under the drawer 38 which forms a piston and does not allow it to come out again. The evacuation of said air is produced by the regulating needle 43.

The bell 40 carries a tube 44 the position of which may be longitudinally regulated in the stuffing box 45 which fixes it on to the bell.

Said bell 40 is situated in the axis of the tube 46 which passes through the perforated sheet-iron 2 supporting the products to be washed.

The bell has no contact with the tube; it is guided by the rod 39 and the drawer 38.

In the case of pneumatic pistons, the pressure in the piston compartment 6 (Fig. 1) is constant; in the case of mechanical pistons it is the volume of water driven back by the piston 47 which is constant.

Such constant volume in water driven back under the washing bed at each piston stroke lifts and raises it into the tube 46 at a height which is all the more great as the washing bed is heavier.

Towards the top of the course, the water

enters the bell 40 whilst driving back the air through the tube 44. When the water reaches the lower level of the tube 44, the upper part of the bell forms a float and carries away the bell up to the end of the course of the water in the tube 46. During this ascension of the bell, the drawer 38 carried away by the rod 39 sucks up the air under it through the valve 42.

When the water goes down again it leaves the bell the lower part of which fills with air through the tube 44 and the whole arrangement, the bell 40 and the drawer 38, drops under the influence of its own weight; the speed of such drop is determined by the needle-screw 43 which regulates the outflow of the air situated under the drawer so that between two pulsations, the drawer 38 should not descend beyond a few millimeters.

It will thus be seen that if with one pulsation the water rises to the same level or higher than with the previous one, it will raise the whole arrangement: the bell 40 and the drawer 38, and that if it does not rise so high, the drawer and the bell will redescend and again rest on the water at the end of the high course as a float would do.

When the bed of slates has reached its maximum of thickness (which is the case of Fig. 7) the pulsation is at a maximum in 46, the drawer is at the end of the high course, the compression chamber 19 is in communication with the atmosphere through the orifices, wide open, and the delivery of slates reaches a maximum through the orifices 23′ as has been explained in the case of the pneumatic piston system.

If the bed of slates is reduced in thickness, the pulsation of the water diminishes parallelly in 46, the drawer descends down the cylinder 35 and progressively laminates the commuication between the compression chamber 19 and the atmosphere until it is entirely cut off, which practically stops altogether the evacuation of the slates.

The tube 44 serves to regulate the position the bell 40 relatively to the water in the be 46, inasmuch as it permits the vertical splacement of the level from which such ater acts on the bell.

What I claim is:

1. In an apparatus for washing coals, the mbination with a vat and a piston chamber mmunicating at the bottom thereof with id bat, said chamber and vat containing ater at a desired level, of means for introducing compressed air into said chamber and discharging same therefrom to produce pulsation comprising an automatic valve, means for dividing the washing bed into three parts, a compression chamber and means controlled by the amplitude of the pulsations for placing said compression chamber in communication with the atmosphere or shutting it off and placing it in communication with piston chamber.

2. In an apparatus for washing coals, the combination with a vat and a piston chamber communicating at the bottom thereof with said vat, said chamber and vat containing water at a desired level, of means for introducing compressed air into said chamber and discharging same therefrom to produce pulsations comprising an automatic valve, means for dividing the washing bed into three parts, a compression chamber, means controlled by the amplitude of the pulsations for gradually placing said compression chamber in communication with atmosphere as the amplitude decreases and as the layer of material increases in thickness and for gradually shutting off said chamber from the atmosphere as the amplitude increases and as the layer of material diminishes.

3. In an apparatus for washing coals, the combination with a vat and a piston chamber communicating at the bottom thereof with said vat, said chamber and vat containing water at a desired level, of means for introducing compressed air into said chamber and discharging same therefrom comprising an automatic valve, means for dividing the washing bed into three parts, a compression chamber, and a valve for controlling the communication of the compression chamber with the atmosphere and with the piston chamber.

4. In an apparatus for washing coals, the combination with a vat and a piston chamber communicating at the bottom thereof with said vat, said chamber and vat containing water at a desired level, of means for introducing compressed air into said chamber and discharging same therefrom comprising an automatic valve, means for dividing the washing bed into three parts, a compression chamber, a valve controlling the communications of the compression chamber, and a float in the piston chamber controlling said valve.

In testimony whereof I affix my signature.

PHILIPPE WOLF.