My invention relates to the washing of coals and ores with running water, on a fixed inclined table or chute provided with openings arranged between movable conjugated separation planes of adjustable size and direction, so as to modify instantaneously the thickness of the fixed alluvion bed, the direction, and the shape and the dimensions of the pit or crater produced by the zone of interruption of the alluvion bed at the level of the conjugated planes. The crater, which is determined by the respective positions of the conjugated planes set by the adjustable intensity of the driving current upstream and downstream of the said planes, is produced in order to enable products of desired density to be intercepted at the desired height or level of the liquid vein. In the case of coal washing, for instance, the adjustment is effected in such a manner that the trajectories described by the schists or slates allow only these products to drop into the crater formed by the planes; conversely the lighter products or coals described above the conjugated planes having such trajectories that they pass, without any other intervention, the artificial crater formed for the purpose. The devices described in the foregoing are sufficient for washing pulverulent products or products of small density; a simple box provided with an adjustable discharge orifice and fitted under each opening, enables the heavy products to be collected and discharged; when it is a question of washing grained products, or very dense products, the process is completed by the arrangement under each opening of an apparatus with a counter-current acting between the conjugated planes. Suitable adjustment of the size and direction of the conjugated planes, and suitable regulation of the driving currents and of the counter-currents, make it possible to obtain the following results: (a) the thickness of the fixed alluvion bed, determined by the size of the planes, remains constant, even in the event of stoppage of the supply of the products to be washed, whereby it is possible to obtain, when starting, a satisfactory normal working; the circulating products are immediately separated owing to the friction of the dense products on the fixed bed; (b) special shapes of crater are obtained, even those the limit of opening of which, measured horizontally, tends towards zero, whilst between the planes is maintained a useful space suitably dimensioned for the discharge; (c) the conjugated planes are arranged in such manner that the charge of the products above the crater remains a minimum, whatever be the variations in quantity of the products carried away; it follows that the intensity of the counter-current acting between the planes, is reduced to a minimum, and that no disturbance of its action is to be feared on account of the variations of supply; (d) the inclination of the planes can be adjusted in such a manner as to allow the heavy flat products (slates in the case of coals) to drop on to one of the planes and to slide on their flattened faces, offering their smallest cross-sections to the action of the counter-current.

Special materials are used for the construction of the separation planes; for instance, glass for the downstream plane, so as to offer the least resistance to the sliding of the flat slates (in case of coal washing). Special arrangements are used in my invention:

1. Supply of a constant quantity of products to be treated to the installations for the first and the second washings.
2. Eventual utilization of a hydro-separator capable of separating at once from the raw product to be treated, the heaviest elements; this arrangement is advantageous in the case of elimination of clayey products which should not be uselessly stirred in order to avoid dilution of the clays.
3. Utilization of one or more chutes or passages for the washing of the initial product and the second washing of certain products extracted; each chute or passage is provided with one or more apparatus with conjugated planes, with or without counter-current; the extraction of the heavy products takes place in a free fall or into a container (hopper-reservoir) communicating with the extractor apparatus. The discharge could be made intermittent or continuous by the use of a distributor.
4. The conjugated planes are extensible and articulated or jointed; they can be moved parallel to one another; the up-stream plane can be made longer or shorter than the downstream plane. Whatever be the opening (measured horizontally) of the crater
formed under these conditions, and even for a limited opening tending towards zero, the free space between the planes remains invariable. This free space, as well as the discharge opening at the base of the passage, are dimensioned as a function of the size of the products to be discharged without fear of obstruction.

5. Perfectly determined constant speeds of the driving current and of the counter-current in the apparatus, obtained by the utilization of water under constant pressure; the intensity of the counter-current between the conjugated planes remains constant as long as they are moved parallelly to one another.

6. Equal distribution of the counter-current throughout the whole width of the opening comprised between the conjugated planes, owing to the use of a narrow passage, and of piping of the width of the passage direction of the counter-current following that of the opening formed by the planes, without sharp bends liable to produce eddies.

7. Utilization of narrow passages for the purpose of uniformly distributing the products to be washed throughout the whole width of the passage, and of counteracting the unfavourable influence of the variations of speed of the driving current in the centre and at the walls of passages which are too wide; two or more narrow passages are placed back to back so as to obtain a passage suitably dimensioned for the supply of the products to be washed.

8. Interpositions of screens between the apparatus in the passages for the first washing and the second washing, for the double purpose of eliminating the driving water and the fine products. The products which do not pass through the screens, are submitted to the action of a driving current of a well determined intensity; this arrangement makes it possible to reduce at will the intensity of the driving current acting on products, the density of which decreases each time that they pass over a separating apparatus.

9. Fractional washing of products, the difference between the extreme dimensions of which is considerable (0 to 15 mm. for instance in the case of coals). To that end the screens above referred to are used, the mesh of which can be made of an increasing size from upstream to downstream, so that the washing rendered more and more difficult by the elimination of elements of decreasing density, is applied to products the difference between the extreme dimensions of which is smaller and smaller; the intensity of the driving current is also more and more reduced, from upstream to downstream.

The fine products passing through the screens, are washed together or separately, after having been submitted, or not, to a preliminary washing or refining by means of hydro-separators.

10. Creation of a fixed alluvium bed containing materials of suitable composition, dimensions, density, these materials being constantly and automatically renewed on suitable points so as (a) to offer always identical slowing causes to the progression of the products to be discharged, (b) to obtain in suitable cases a well determined volume of movable dense elements serving as obstacles for the dense products to be separated by washing, (c) to prevent the introduction in the intervals between the dense elements constituting the upper part of the fixed bed, of pulverulent products able to form a pasty bed without any asperities, (d) to realize the greatest difference possible between the speeds of the elements to be separated by washing, i.e., to obtain firstly the smallest speed possible for the elements of greater density (introduced in the artificial movable bed in contact with the fixed alluvium bed) which are to be intercepted in the separator planes and secondly the greatest speed possible for products of smaller density at the upper part of the liquid current which are to be driven beyond the suitable disposed separator planes.

The process utilizing these properties is illustrated in the accompanying drawing in which: Figures 1, 2, 3, 4 and 5 show diagrammatically sections of washing passages or chutes provided each with differently regulated conjugated separator planes; referring to these figures, the arrow shows the direction of the driving current and the hatchings the thickness of the fixed alluvium bed; / is the opening of the pit or crater to be traversed, and / is the level difference between the upstream and downstream planes.

Figures 6 and 7 show diagrammatically the trajectories described by the products to be separated.

Figs. 8-12 are diagrammatic sections showing modifications.

Referring now to Figures 1 and 6, the separator planes are regulated in such a manner that the edge of the downstream plane is situated at the exact point where the differences of deviation between the trajectories described by the products to be separated are greatest.

Figure 4 shows an arrangement in which the width of the crater to be traversed is very small and which is especially applicable to the discharge of very dense products, the fall of which is almost vertical; with this arrangement the quantity of water used for the free fall of heavy products is very small.

Fig. 5 shows another regulating arrangement in which the conjugated separator planes are inclined in the upstream direction.
instead of being inclined in the downstream one as in the above described arrangements; this arrangement is to be used with heavy flat products sliding during their fall upon the upstream plane.

Fig. 8 shows an embodiment of adjustable conjugated separator planes; pin holes 1 provided in operating planes 2, enable these planes to be locked in the desired position on a quadrant, so as to vary their direction and length. A box 3 for the discharge of heavy products is fitted under the opening of the passage.

Figure 9 shows another embodiment of the apparatus with a counter-current acting between the conjugated planes; the planes 4 are divided in two sliding parts, so as to vary their length, and are rotatable on suitable hinges. The dense products are received in a hopper-reservoir 4 connected to the apparatus 5 by means of a tight joint; the discharge or emptying of the reservoir takes place intermittently or continuously through a sliding trap or any other well known means such as rotary distributor.

Fig. 10 shows an installation for washing fine products. A is a hopper containing the product to be washed and operating constant discharge of the product in the washing passage. B, C are two apparatuses for discharging products of the greatest density. D is a screen and hydro-separator device, the object of which is to eliminate the water and to extract from the fine products passing through the screen the elements of greater density which have to be washed again. E is an overflow for the water and light fine products rejected by the hydro-separator. F is a passage for the second washing of the fines discharged from the hydro-separator D. G is a passage for the second washing of the products refined by the apparatuses C and freed from the fines. H refers to two washing-apparatuses supplying the passage I for the second washing. J is an apparatus for discharging heavy products. K refers to hopper-reservoirs receiving the heavy products; similar hoppers may be provided under the apparatuses H for supplying a constant quantity of products to the passage I for the second washing. L indicates cocks for regulating the intensity of the driving current.

Fig. 11 is a cross section of a washing passage 7 provided with vertical separations 8.

Fig. 12 refers to an arrangement allowing of a constant renewal of the fixed alluvion bed. A refers to a hopper-reservoir containing the products to be washed and supplying a constant quantity of products to the washing passage B. C is a hopper-reservoir containing the products provided for the renewal of the alluvion bed constituted upstream as regards the conjugated planes. D. E indicates a hopper-reservoir containing the products provided for the renewal of the alluvion bed constituted upstream as regards the conjugated planes E. The composition of the products provided for the hopper C may be of course different from the composition of the products provided for the hopper E.

Claims—

1. In an apparatus of the character described, a fixed inclined table having openings at intervals thereon, and adjustable separator planes located at the openings, said planes being arranged in pairs in the openings and the planes of each pair being arranged in permanent parallel relation.

2. In an apparatus of the character described, a fixed inclined table having openings at intervals thereon, and adjustable separator planes located at the openings, said planes being arranged in pairs in the openings and the planes of each pair being arranged in permanent parallel relation and being relatively movable.

In testimony whereof I hereunto affix my signature.

CLÉMENT CLOUWEZ.