

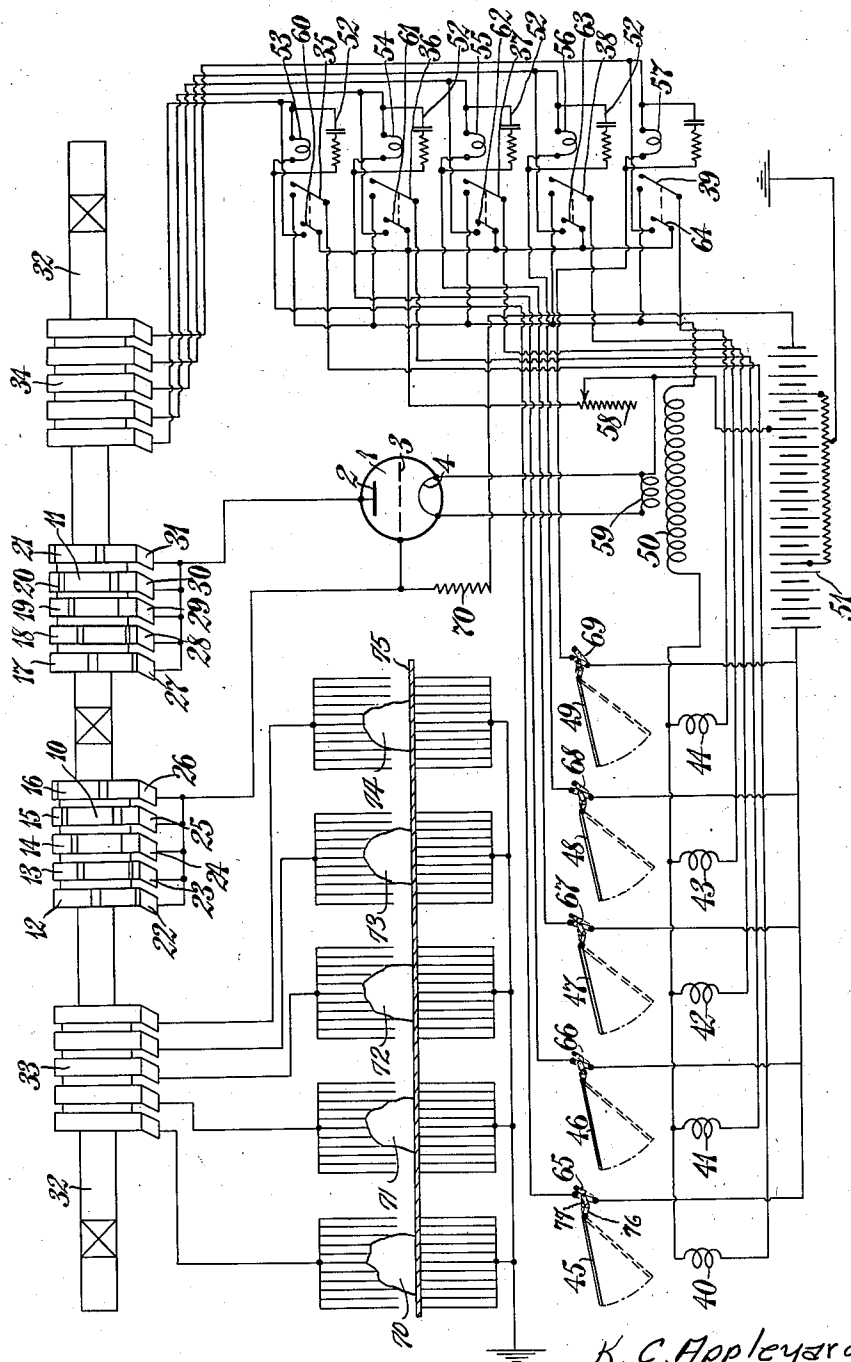
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APPARATUS FOR THE ELECTRICAL SEPARATION OF COAL

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UNITED STATES PATENT OFFICE

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APPARATUS FOR THE ELECTRICAL
SEPARATION OF COAL

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2 Claims. (Cl. 209—81)

This invention relates to the separation of coal by electrical discrimination, and especially to apparatus for separation according to our British Patent No. 421,401, but it is not limited to such apparatus, especially, for instance, as regards voltages and amplification.

The object of the invention is to provide an improved or modified apparatus, especially from the aspect of reducing the valve requirements in a number of machines working together, or in a machine of what might be called a multi-pass type, that is, where a number of sets of discriminating brushes or the like come into question.

The invention in brief consists in apparatus for the sorting of coal by electrical discrimination, in which the different conductivity or like effects produced in an electric circuit by the passage of the coal being sorted, which coal forms part of that circuit, are used to control a single electric discharge tube, which is rendered available to a plurality of machines or coal separating paths, for instance, constituted by means of a conveyor band passing the coal through gaps between resilient electrical contacts, which electrical discharge tube acts to determine the disposition of the sorted materials.

The invention also consists in apparatus according to the preceding paragraph in which the electric discharge tube is rendered available to a plurality of discriminating devices by means of two or more commutators or rotary switches rotated at a sufficiently high speed, one of these commutators being in connection with the anode of the discharge tube, and a series of relay circuits, dealing with the control of the discharge arrangements, or with the maintenance of a suitable time interval by holding-on circuits, or by other desired devices, and another commutator being associated with the grid of the valve, and the discriminating devices.

The invention also consists in apparatus according to either of the preceding two paragraphs, in which direct current is employed in connection with the devices associated with the anode commutator, and alternating current is employed in connection with the cathode side of the electric discharge device.

The invention also consists in apparatus for the sorting of coal, substantially as herein described.

One way of carrying the invention into effect by way of example will now be described with reference to the accompanying drawing, which represents diagrammatically a scheme for the

electrical separation of coal from associated impurities.

Referring to the drawing, a grid controlled mercury vapour filled discharge tube 1 having an anode 2, a grid 3 and a cathode 4 is used to deal with a conveyor band 75 constituting five coal separating channels 70 to 74 in each of which a piece of coal is shown, each of which has what may be termed discriminating fingers in sets at right angles suitably electrically connected, as shown conveniently in Figure 1 of the drawing accompanying the complete specification of British Patent No. 421,401, especially taken in conjunction with Figures 7 and 8 of that patent.

The discriminating devices numbered 5 to 9 and the valve 1, with its associated circuits, are co-related by means of two five-part commutators, 10 and 11 respectively, each commutator consisting of five elements 12 to 16 and 17 to 21 corresponding in number to the five cleaning channels, and each element being divided into four sections mutually opposed at right angles, the four sections of each element being electrically connected.

The commutators 10 and 11 have co-operating brushes 22 to 26 and 27 to 31 respectively which are electrically connected in each commutator. In the case of the commutator 11, a connection is made from the brushes to the anode 2 of the valve 1, and in the case of the other commutator 10, a connection is made from the brushes to the grid 3 of the valve 1. For convenience, the commutators will therefore be referred to respectively as the anode and grid commutators.

Each of the above mentioned conductive sections of the commutator elements is of such a peripheral length that when the five elements of the commutators are fixed on the shaft 32, they may be so adjusted relative to one another that their corresponding brushes will make contact with only one section at a time, and in a complete revolution of the shaft 32 each brush will have made four contacts on the corresponding element of the commutator or in all twenty separate contacts will have been made by the set of brushes. The peripheral length of the contact also bears such a relation to the diameter of the commutator that the brushes in passing from one segment to another pass over a space of insulation.

The commutators are mounted on the hollow shaft 32 which is capable of being rotated at high speed, and on this shaft two sets of slip rings 33 and 34 are mounted, each set comprising five rings of conductive material, with co-operat-

ing brushes, the rings being insulated from the shaft and connected by leads passing through the inside of the shaft to their respective commutators 10 and 11. The rings which are thus joined to the grid commutator have their respective brushes connected to one side of the discriminating fingers 5 to 9, the other side of these fingers being connected to "earth."

The brushes of the set of slip rings 34 which are associated with the anode commutator 11 are electrically connected with a series of relay switches 35, 36, 37, 38 and 39. These relays when actuated energize solenoids 40, 41, 42, 43 and 44 which in turn open and close doors 45, 46, 47, 48 and 49 for the passage of one of the separated constituents, for example, stone (compare the hinged flaps shown in positions 40 and 44a in British specification No. 421,401). They may also control known "hold-on" circuits by way of auxiliary switches 50, 51, 52, 53 and 54 mechanically connected to the aforesaid relay switches, the function of the auxiliary switches being to see that the circuit is closed for a suitable time, and remains closed for a longer period than would be permitted solely by the valve action, having regard to the high speed of rotation of the commutator shaft 32, which speed may be for example between 700 and 2,000 revolutions per minute.

The power for the door operating solenoids 40 to 44 is conveniently derived from a source of alternating current 50 of substantial amount, for instance, at a high voltage, say 440 volts, and 50 cycles periodicity. The power for the relays is provided by a source of direct current, such as the battery 51 or a motor generator, of voltage suitable for the work, say between 100 and 800 volts. When a battery is used, a number of cells are tapped off and connected to "earth", which really means that the "earth" connection is at some potential above earth, and this may be varied.

The relay coils 53 to 57, which may have resistance-capacity circuits 52 connected in parallel as shown in the drawing, are connected to the positive end of the battery 51 through door limit switches 55, 56, 57, 58, 59 at the end of the relay coils remote from the slip rings, and are thereby always at a positive potential. From the other end of the relay coils 53, 54, 55, 56 and 57 connections are taken to the slip rings 34 and thence via the commutator 11 to the anode 2 of the valve 1. From this same end of each relay coil a connection is taken to one side of the corresponding auxiliary switch, of the group 60 to 64, and from the other side of this auxiliary switch a connection is taken to the negative end of the battery 51 through a rheostat 58. Should one of the relay switches, say 35, momentarily close due to the passage of current in the valve 1, the corresponding auxiliary switch 60 will retain a circuit through the solenoid 40 until the door 45 opens fully, so opening the limit switch 55 associated with it. In place of limit switches which open and break the circuit when the doors reach the fully open position switches may be mounted inside the doors in such a position that the pieces of material passing through the doors will open the said switches and break the circuit. The cathode 4 of the valve 1 is heated by a step-down transformer winding 59 from the source of alternating current 50.

In operation, the "coal" to be classified passing along any of the distributing channels is "tested" by a rapid series of impulses, due to the combined action of the high speed commutators 10 and 11 and the valve 1, and in accordance with the result

of the test, it is caused to pass to the appropriate destination, that is, either through the trap doors or not through the trap doors 45 etc. The duration of contact of the brushes on any one segment of the commutator is of such small magnitude that should the valve pass current during the contacting period of this segment and the condition of the grid circuit have changed before another contact is made on this commutator so that current does not now pass, then such a single impulse is insufficient to energize the relay to such an extent as to make its associated auxiliary switch "make" the hold-on circuit, and the door will therefore remain closed. The distance through which the relay parts must pass as a result of the passage of current in the valve itself before "making" contact on its auxiliary switch may be adjusted. Because of the very small inertia of the valve and the comparatively immense inertia of the relay parts, we are enabled to integrate the resistance of any piece of material as it passes through the brushes. Thus, if during the passage of a piece of material through the brushes the valve is connected thereto twenty times by the revolving commutators and passes current on fifteen occasions, the relay auxiliary switch can be so adjusted as to make contact and operate the trap door. By means of this integrator we are therefore enabled to separate hard coal from soft because of the greater conductivity of the hard. This has been extremely difficult up till now, because of the fact that all soft coal contains streaks and laminations of hard which on making contact with the brushes operated the relay and opened the trap door.

General

The grid circuit of the valve 1 may be connected through a resistance 70 to the negative side of the battery. It is therefore always at negative potential, but at a potential lower than that of the filament. The anode is always at a constant potential but due to the revolving commutators this potential is obtained via the different relay coils in turn, while the grid has applied to it the potentials of the various discriminating fingers in turn, which potential is dependent upon the nature of the piece of material at that instant between the said contacting fingers. The commutators being mechanically mounted on one shaft ensure that the anode current will always flow through the relay coil corresponding to the contacting finger which is at that instant supplying the grid potential. Because direct current is used there can never be any phase lag between the anode and grid, due, for example, to varying capacities of the material. The holding-on circuits give time for the doors to be opened, notwithstanding the fact that perhaps many impulses will have followed in the valve before in fact opening takes place.

We have found that by using a single selector valve circuit for a plurality of discriminating paths, in addition to the economy in valves, wiring and other matters, obtained in this way, in comparison with a single valve operating a single unit, there appear to be other advantageous effects, especially, for instance, when the "coal" is even quite wet, because matters can be so adjusted that the valve will distinguish between the constituents of wet "coal", and permit the wet "coal" to pass, while rejecting the wet "stone".

We claim:

1. Apparatus for sorting coal comprising a single

grid controlled electric discharge tube, a set of flexible contacts for testing the coal, a multiple rotary switch adapted to complete a circuit successively with the flexible contacts arranged to
5 contact pieces of coal fed along a plurality of separate parallel paths and a source of direct current in an electrical circuit which is arranged to influence the potential of the grid of the discharge tube, a set of relays, a second and corresponding multiple rotary switch and a source of
10 direct current in the anode circuit of the dis-

charge tube and path selecting devices operated by a source of alternating current and influenced by the current in the anode circuit of the discharge tube to determine the path of each piece of coal.

2. Apparatus for sorting coal electrically as
5 claimed in claim 1 including a conveyor band along which the coal is passed through gaps between resilient electrical contacts.

KENELM CHARLES APPELEYARD.
STANLEY DALLAS POLLITT.

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CERTIFICATE OF CORRECTION.

Patent No. 2,086,060.

July 6, 1937.

KENELM CHARLES APPELYARD, ET AL.

It is hereby certified that the above numbered patent was erroneously issued to "The Birtley Company Limited" as assignee of the entire interest in said invention whereas said patent should have been issued to the inventors, Kenelm Charles Appleyard and Stanley Dallas Pollitt, and the Birtley Company Limited, said company being assignee of one-third interest only in said invention, as shown by the records of assignments in this office; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of October, A. D. 1937.

Henry Van Arsdale.

Acting Commissioner of Patents.

(Seal)