Feb. 6, 1940. J. L. EIGENBROT 2,189,711

METHOD FOR PREPARING COAL

Filed April 26, 1938 3 Sheets-Sheet 1

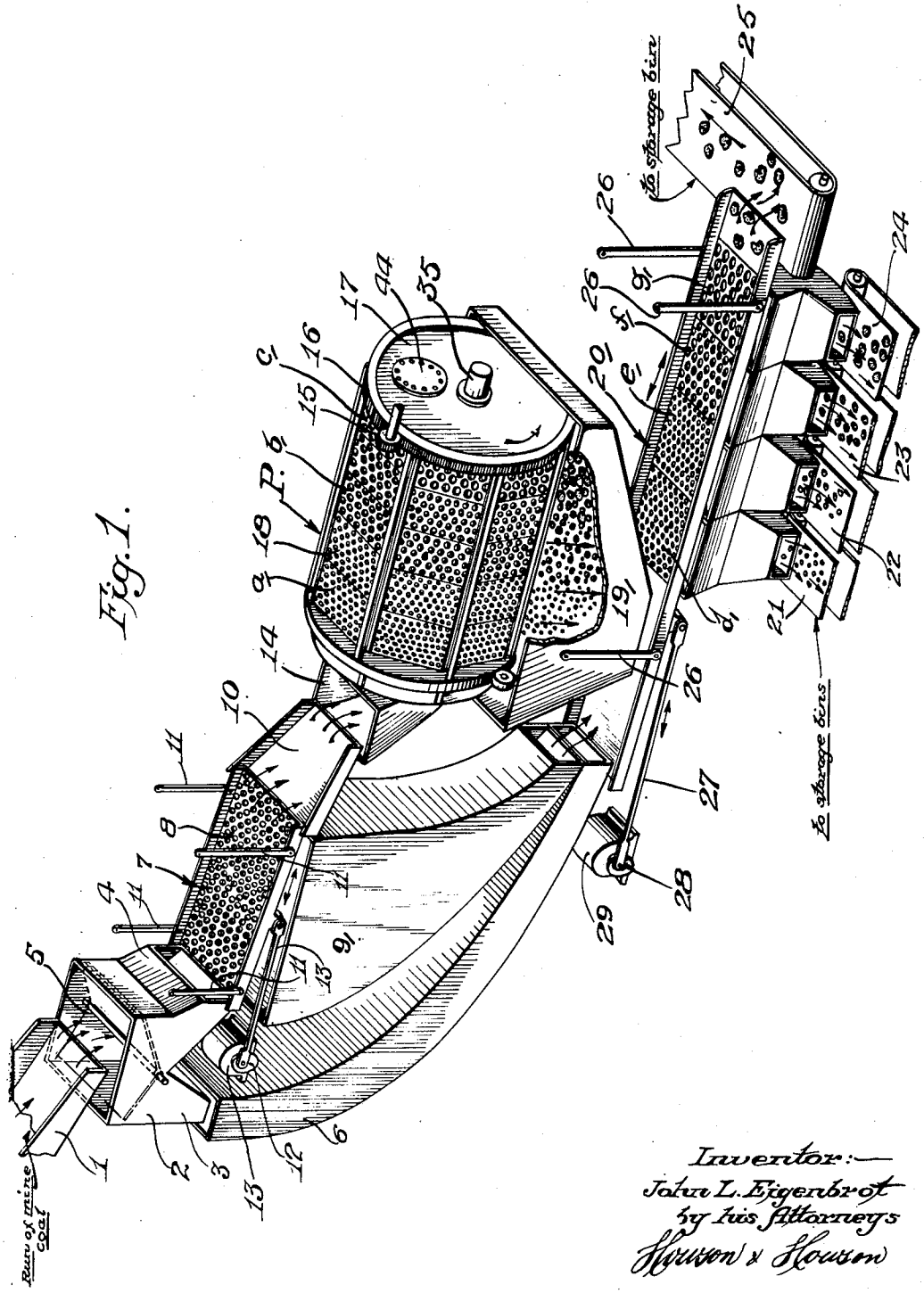


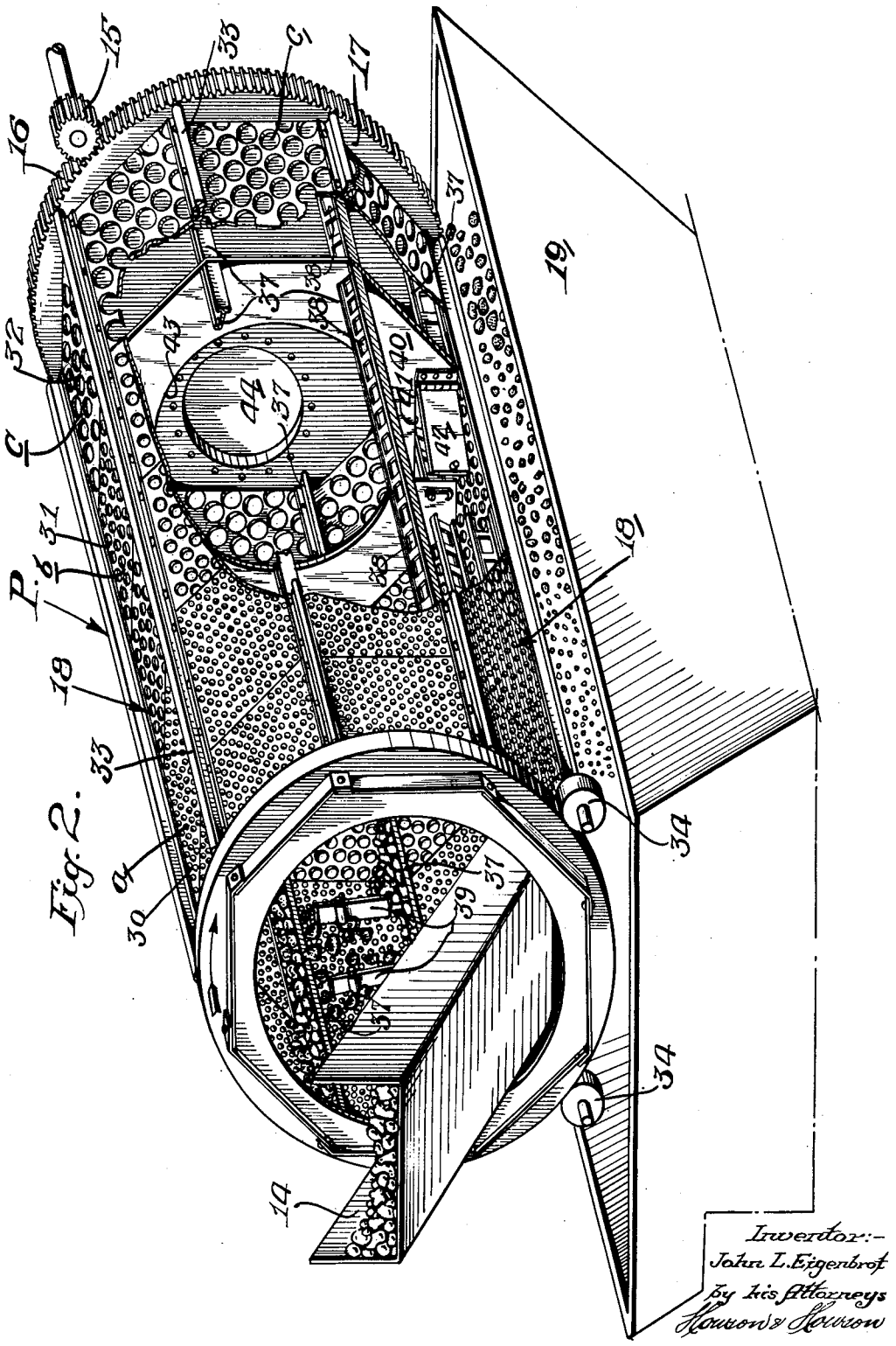
Fig. 1.

Inventor:—
John L. Eigenbrot
by his Attorneys
Howson & Howson

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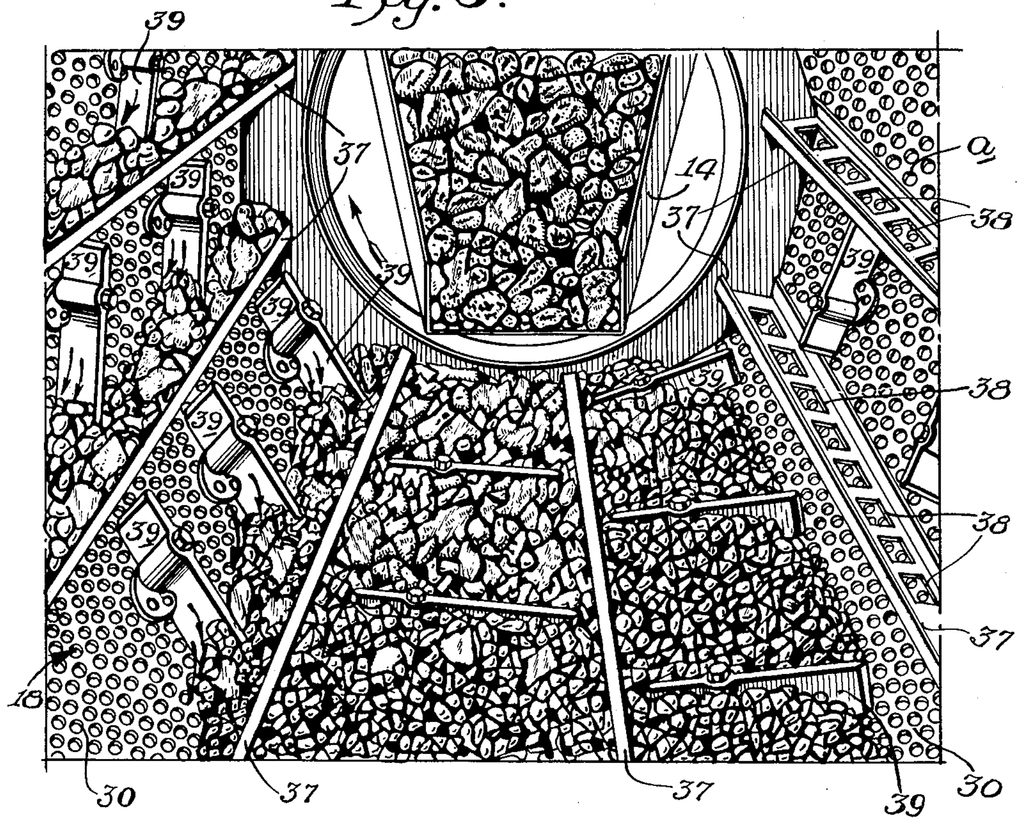


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Fig. 3.



Inventor:—
John L. Eigenbrot
by his Attorneys
Howson & Howson

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2,189,711

METHOD FOR PREPARING COAL

John L. Eigenbrot, Upper Darby, Pa., assignor to Westmoreland Coal Company, Philadelphia, Pa., a corporation of Pennsylvania

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4 Claims. (Cl. 209—6)

This invention relates to a new and useful method for preparing and separating materials such as coal, stone, ore and the like into two kinds, namely, one that is physically strong and one that is physically weak.

Taking coal as an example, as it exists in its natural bed it is a product of nature and like all products of nature, it is not uniform in composition, structure and strength. If a bed of coal, particularly bituminous coal, be examined from the bottom to the top of the bed, many distinct strata of coal will be found, and these strata will vary in composition, structure and strength. Some strata will consist of weak friable coal while other strata consist of strong tough coal, and still other strata of part strong coal and part weak coal; also the degree with which adjacent strata adhere to each other will vary greatly. In addition to the coal substance, occurrences of stone, slate and other impurities are included in the bed of coal.

As the coal is removed from its natural bed and loaded into mine cars it consists of a miscellaneous mixture of all the various kinds of coal of which the bed was composed, including any impurities which lay in the bed. There will be specimens of strong coal, of weak coal and of partly strong and partly weak coal banded together. There will be found a great variation in the size of the various pieces and some pieces may be so large as to weigh more than 200 lbs. whereas other pieces may be classified as dust. Between these limits, pieces of innumerable intermediate sizes will be found. This mingled mixture of coal, including impurities in the coal as it is loaded into mine cars is termed run-of-mine coal.

While all of the coal as it is brought out of the mine is of the run-of-mine size, not all of the coal shipped to the market is of the run-of-mine size. There is an increasing demand for numerous other sizes, depending upon the manner in which the coal is to be used. For this reason, some of the run-of-mine coal is classified into various sizes, such as for instance, four by six inches, two by four inches, three-quarters by two inches, and so forth, by passing the run-of-mine coal over a screen or screens provided with sections containing certain size openings. By this means run-of-mine coal can be screened so as to obtain a portion which will not pass through a four-inch opening but all of which will pass through a six-inch opening thus producing a portion having a general size of four by six inches. In like manner portions having other sizes are screened out of the run-of-mine coal by using suitably sized openings in the screen.

Due to the constant progress which is being made in the design and operation of coal consuming equipment and a likewise progress in the various processes in which coal enters, the combustion or reaction of coal is becoming more and more precise. Not only is the composition of the coal important; its size may be equally important and in some cases may be of even greater importance. The rate of combustion or reaction of a piece of coal is proportional to the ratio of its surface to its mass, and the greater this ratio the higher will be the rate of combustion or reaction. The effect of size upon the ratio of surface to mass may be illustrated by comparing three pieces of coal with each other, one piece being a cube measuring four inches, another measuring two inches and another measuring one inch. In the case of the four inch cube the ratio of surface to mass is 1.5 to 1; while in the case of the two inch cube the ratio is 3 to 1, and in the case of the one inch cube the ratio is 6 to 1. Manifestly where the coal varies in size between the limits of four inches and one inch, uniform combustion or reaction cannot occur, hence in the processes where sized coal is required that coal which will resist the physical stresses imposed upon it during transportation and subsequent handling will be preferred.

The processes of making water gas and producer gas are examples of cases where screened coal is used to provide a fuel bed of uniform condition that will yield high efficiency and large capacity of the equipment. Manifestly even though coal be carefully screened so as to keep the component parts of a certain size, between narrow limits at the time it is loaded into railroad cars, if such screened coal is not sufficiently strong to withstand the physical stresses imposed upon it before it is used, it will break and degrade in size thereby impairing its performance and reducing its value. Coal gas retorts can also be cited as cases where uniformity of size is important and where degradation of size due to breakage is equally objectionable.

There are other cases where the size of the coal is unimportant. Such cases for example are coke ovens and steam boilers in which powdered coal is used as fuel. In the case of coke ovens it is the common practice to mix two or more coals in order to produce coke having specific properties, and in order to blend the coals entering the mixture they are pulverized, hence in this case the size of the coal at the time of shipment

from the mines is unimportant, in fact the smaller the size of the coal the less will be the expense of pulverization. Further, there is no objection to weak soft coal, in fact it is preferred to strong tough coal because of the easier tasks of pulverizing it.

From all of the foregoing it is clear that the coal market includes consumers of at least two classes, one in which strong coal of uniform size is required and another in which weak soft coal is required. With this premise in mind, the principal object of the present invention is to provide a novel method of preparing and classifying or separating materials such as coal and the like wherein the coal is deliberately subjected to physical forces to break the weaker coal and to remove from the stronger coal that weaker coal which is banded to it, thus separating the weak coal substantially entirely from the strong coal.

Another object of the invention is to provide a method of the type described wherein the strong coal thus separated from the weak coal may be continually subjected to physical forces to reduce the size thereof to meet market requirements.

Another object of the invention is to provide a method of the type described wherein the strong coal thus separated from the weak coal is subjected to physical forces to round off the sharp edges and corners thereof to meet market requirements.

A further object of the invention is to provide a method of the stated character wherein the separated and reduced weak and strong coal are classified or separated into the various sizes desired to supply the market requirements.

These and other objects of the invention and the features and details of its operation are hereinafter fully set forth and shown in the accompanying drawings, in which:

Figure 1 is a diagrammatic view in perspective of one form of apparatus which may be employed to carry out the present invention.

Figure 2 is an enlarged view in perspective of what may be termed a preparator having certain portions thereof cut away to illustrate various details of its construction, and

Figure 3 is a fragmentary view in perspective of the interior of the preparator shown in Figure 2.

Referring now more particularly to the drawings, reference numeral 1 designates a declining chute from which run-of-mine coal is discharged into a hopper 2 provided with two outlet chutes 3 and 4 respectively. As shown, the hopper 2 is provided with a plate valve 5 arranged so that run-of-mine coal may be discharged from said hopper through either outlet chute 3 or 4 as may be desired to a chute 6 or onto a scalping screen 7 respectively.

The scalping screen 7 is provided with a perforated bottom plate or wire mesh material 8 for the purpose of separating and removing the fine coal from the coarse coal. Of course, should it be desired to eliminate this scalping step, the bottom surface of the screen 7 may be covered with a suitable imperforate plate or sheet (not shown); however, in most instances, the run-of-mine coal will be scalped and in order to more clearly describe the present invention, this scalping step or operation should be further described. In this regard, the plate 8 of the scalping screen has perforations therein of, for example, say two inches with the result that as the run-of-mine coal passes therealong from the hopper 2, all the coal of minus two-inch size will pass through said perforations in the plate 8 and be discharged into a chute 9 by means of which this minus two-inch coal is conducted to a screen conveyor described in detail hereinafter. The coal which is plus two inches in size, however, will remain in the scalping screen 7 and is conveyed by it to a discharge chute 10.

In order to facilitate scalping of the run-of-mine coal and convey the plus two-inch size coal toward the discharge chute 10, the scalping screen 7 is preferably of the reciprocating conveyor type suitably suspended upon pivoted arms 11 and reciprocated by means of an eccentric 12 which is driven by a motor or other suitable source of rotary power 13. Upon reaching the chute 10, the coal is conveyed by said chute and discharged into a chute or hopper 14 which leads into the interior of a preparator, designated generally by the letter P, where said coal of plus two-inch size is treated or prepared and classified with respect to physical strength and size.

As shown particularly in Figure 2 of the drawings, the preparator P is mounted for rotation about its longitudinal axis, being driven from a suitable source (not shown) through a gear 15 which meshes with the gear teeth 16 formed on the circumference of the imperforate wall 17 which completely closes the end of the preparator opposite the inlet end thereof. The preparator P is divided into a suitable number of sections, three being illustrated and designated *a*, *b* and *c* respectively, and the walls 18 thereof are perforated, for example, by providing say two-inch holes or openings in section *a*, four-inch openings in section *b*, and six-inch openings in section *c*. Through these openings in the walls 18, coal of corresponding sizes will pass from the preparator P into a hopper-chute 19 which feeds the assembled coal upon a screen conveyor 20 upon which the minus two-inch scalpings have been fed by means of the chute 9 previously described. This screen 20 is provided with a series of sections *d*, *e*, *f* and *g* having therein one-half, one, two and four inch openings respectively, thus enabling the screen 20 to separate and classify the coal received thereon into sizes of approximately zero by one-half inch, one-half by one inch, one inch by two inches, two inches by four inches and four inches by six inches respectively. These several sizes will each pass through the respective sections of the screen 20 onto conveyors 21, 22, 23, 24 and 25 which deliver their respective coals to railroad cars, to trucks or to storage bins, or if desired suitable chutes may be substituted for the conveyors 21, 22, 23, 24 and 25 to deliver the coal by gravity directly into railroad cars or trucks.

Should it be desired to eliminate scalping and preparation of the run-of-mine coal with respect to the strength thereof, that is, to eliminate separation of the strong coal from the weak coal, the plate valve 5 in the hopper 2 is positioned so that the run-of-mine coal will discharge through the chute 3 to a chute 6 by means of which it is fed onto the screen 20 where it will be screened into the sizes previously mentioned with the exception of the four by six-inch sizes which in this case will consist of four-inch lump coal.

The screen 20, as the case of the screen 7, is suspended in the ...ual manner by straps or links 26 from suitable supports, (not shown), and a reciprocating motion is imparted thereto through a connecting rod 27 by means of an eccentric 28 driven by a suitable motor 29.

The foregoing describes the particular course or flow of the coal as contemplated by the present invention, and at this time it is essential that considerable attention be devoted to a detailed description of the construction and functions of the preparator P. As shown, the preparator P consists essentially of a wall 18 composed of perforated metal plates 30, 31 and 32, suitably fastened to a metal frame 33, the whole of which rotates about its longitudinal axis upon rollers 34 and journal 35. The preparator P is provided with shelves 37 arranged internally and longitudinally thereof to lift the coal during the rotation of said preparator to a point where said coal will fall from said lifting shelves 37 onto the perforated plates 30, 31 and 32, thereby subjecting the coal to physical forces so as to cause the weak coal to break into smaller sizes and also to break off from the pieces of strong coal to which it may adhere. The lifting shelves 37 are provided with openings 38 therein so that only that which is too large to pass through said openings 38 will be raised and dropped by the shelves 37. The lifting shelves 37 are detachably mounted within the preparator P to permit the number employed in any instance to be varied and to permit changes in the sizes of the openings 38 depending upon physical nature of the coal and the extent to which large pieces of strong coal are to be reduced in size. That part of the coal which is not lifted and dropped through the openings 38 in shelves 37 will be subjected to a rolling and tumbling action which will remove or break from the strong coal any weak coal that may be attached to it, and will further cause the sharp edges and corners of the strong coal to be worn away and rounded.

In addition to the shelves 37 the preparator P is provided with pusher plates 39 arranged internally thereof at an angle with reference to the axis of said preparator P so that as the latter rotates the coal will be moved from the receiving end of the preparator to the opposite end thereof. The angularity of the pusher plates 39 is adjustable so that the pushing effect may be increased or decreased depending upon the speed with which it is desired to move the coal through any one or all of the various sections *a*, *b* and *c* of the preparator. This factor is also controlling as respects the particular number of pushers 39 employed in any one instance or treatment of the coal. A partition 40 is provided between sections *b* and *c* of the preparator P and this partition 40 has one or more openings 41 therein to permit coal which will not pass through the four-inch holes in section *b* to enter section *c*, closures 42 being provided for said openings 41 in the partition 40 so that, in instances where it is desired to prepare the coal so that all of it will pass a four-inch opening of section *b*, passage of said coal into section *c* may be prevented. Similarly by providing a similar partition between sections *a* and *b* of the preparator and closing the openings therein, all of the coal will be retained in said section *a* where it will be reduced and prepared until it passes through the two-inch openings of that section. The partition 40 is provided with a concentric or central opening 43 therein to permit a man to pass from section *c* to section *b* should such an occasion arise and a manhole having a suitable cover 44 in the closed end wall to permit ready entrance to, and exit from the preparator.

All of the run-of-mine coal may be treated in the preparator P by covering the perforated plate 8 of the scalping screen 7 as previously described, although said scalping screen 7 is usually utilized for the purpose of relieving the preparator of coal having a size which is not to be prepared with respect to strength of the coal, and referring to Figures 2 and 3, the plus two-inch coal will be seen in the chute 14 just as it is about to enter the preparator P which is rotating in the direction of the arrow, arrows being also employed to illustrate the travel of the coal longitudinally through the preparator as effected by the pusher plates 39. Under the influence of the lifting and falling action together with the rolling and tumbling action imparted to the coal, said coal will be prepared or separated into strong coal and weak coal. This involves a reduction in size, and that part of the coal which is reduced to a size not larger than two inches will pass through the openings in the walls of section *a* into the hopper 19 and hence be removed from the zone of action. The coal remaining in the preparator is, however, subjected to continued action, and, under the influence of the pusher plates 39 enters section *b* where all of the coal that is a minus four-inch size will pass through the holes in the walls of said section *b* to the hopper 19 and hence be removed from the zone of action. That coal which still remains in the preparator will be subjected to continued action and under the influence of the pushers 39 will enter section *c* from which all of the remaining coal that is of a minus six-inch size will pass through the openings in the walls of said section *c* into the hopper 19 and hence out of the zone of action; but that remaining coal which is of a plus six-inch size is retained in section *c* and continuously subjected to the tumbling and reducing action of the preparator until it is reduced to a minus six-inch size so as to pass through the openings in the walls of said section *c* into the hopper 19.

The continuous action of the preparator P upon the coal will, of course, produce a small amount of coal of fine size irrespective of the section of said preparator in which the action occurs, for example, a piece of coal of such size as permitted it to enter section *c*, that is, larger than four inches, may, under the action of the preparator be reduced to say three pieces two of which may pass through a one-inch hole. Such small pieces of coal would be objectionable if contained in coal of four by six-inch size. To overcome this objection the entire product of the preparator is therefore gathered together upon the screen 20 and classified into various sizes, which need not necessarily be correlated with the size of the holes in the several sections of the preparator, but it is essential that at least two stages be established and correctly phased with respect to each other.

From the foregoing it will be seen that the present invention provides a novel and effective method or process for preparing and separating coal into strong coal and weak coal, wherein all of the coal received by the preparator is subjected to physical forces which break the weak coal and separate it from the strong coal, which is thereafter reduced to predetermined sizes as may be desired or required, the preparator being provided with means for increasing and decreasing the velocity through which the coal passes through each section of the preparator, as well as means for increasing or decreasing the amount of lifting and falling action and the tumbling and rolling action to which the coal is subjected in any and all of the sections of the preparator P. The preparator is so constructed that coal entering

the same is retained therein and subjected to a preparatory action until the desired end product is obtained, thus avoiding recycling of the coal through the preparator.

While a particular embodiment of the invention has been illustrated and described herein, it is not intended that said invention shall be precisely limited thereto but that changes and modifications may be incorporated and embodied therein within the scope of the annexed claims.

I claim:

1. The method of preparing coal which comprises advancing a mass of coal of assorted sizes progressively through a series of selective separating stages arranged to separate out coal of increasing size progressively through the series, continuously subjecting said coal to physical breaking forces while in the separating stages to reduce the coal into pieces which increase in strength and size as during progress of said coal through said stages, and selectively separating out the reduced coal from the separating stages.

2. The method of preparing coal which comprises advancing a mass of coal of assorted sizes progressively through a series of selective separating stages arranged to separate out coal of increasing size progressively through the series, continuously subjecting said coal to physical breaking forces while in the separating stages to reduce the coal into pieces which increase in strength and size as during progress of said coal through said stages, selectively separating out the reduced coal from the separating stages, and controlling the speed of progression of said coal through said separating stages to regulate the reduction and separation in each separating stage.

3. The method of preparing coal which comprises advancing a mass of coal of assorted sizes progressively through a series of selective separating stages arranged to separate out coal of increasing size progressively through the series, continuously subjecting said coal to physical breaking forces while in the separating stages to reduce the coal into pieces which increase in strength and size as during progress of said coal through said stages, selectively separating out the reduced coal from the separating stages, collecting the separated portions of coal without regard to the size and physical strength thereof, and then classifying said coal into groups according to size.

4. The method of preparing coal which comprises advancing a mass of coal of assorted sizes progressively through a series of selective separating stages arranged to separate out coal of increasing size progressively through the series, continuously subjecting said coal to physical breaking forces while in the separating stages to reduce the coal into pieces which increase in strength and size as during progress of said coal through said stages, selectively separating out the reduced coal from the separating stages, controlling the speed of progression of said coal through said separating stage to regulate the reduction and separation in each separating stage, collecting the separated portions of coal without regard to the size and physical strength thereof, and then classifying said coal into groups according to size.

JOHN L. EIGENBROT.