H. E. KIEFER.

COAL FEEDING APPARATUS FOR ROTARY CEMENT KILNS, &c.

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993,604.

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Fig. 1,

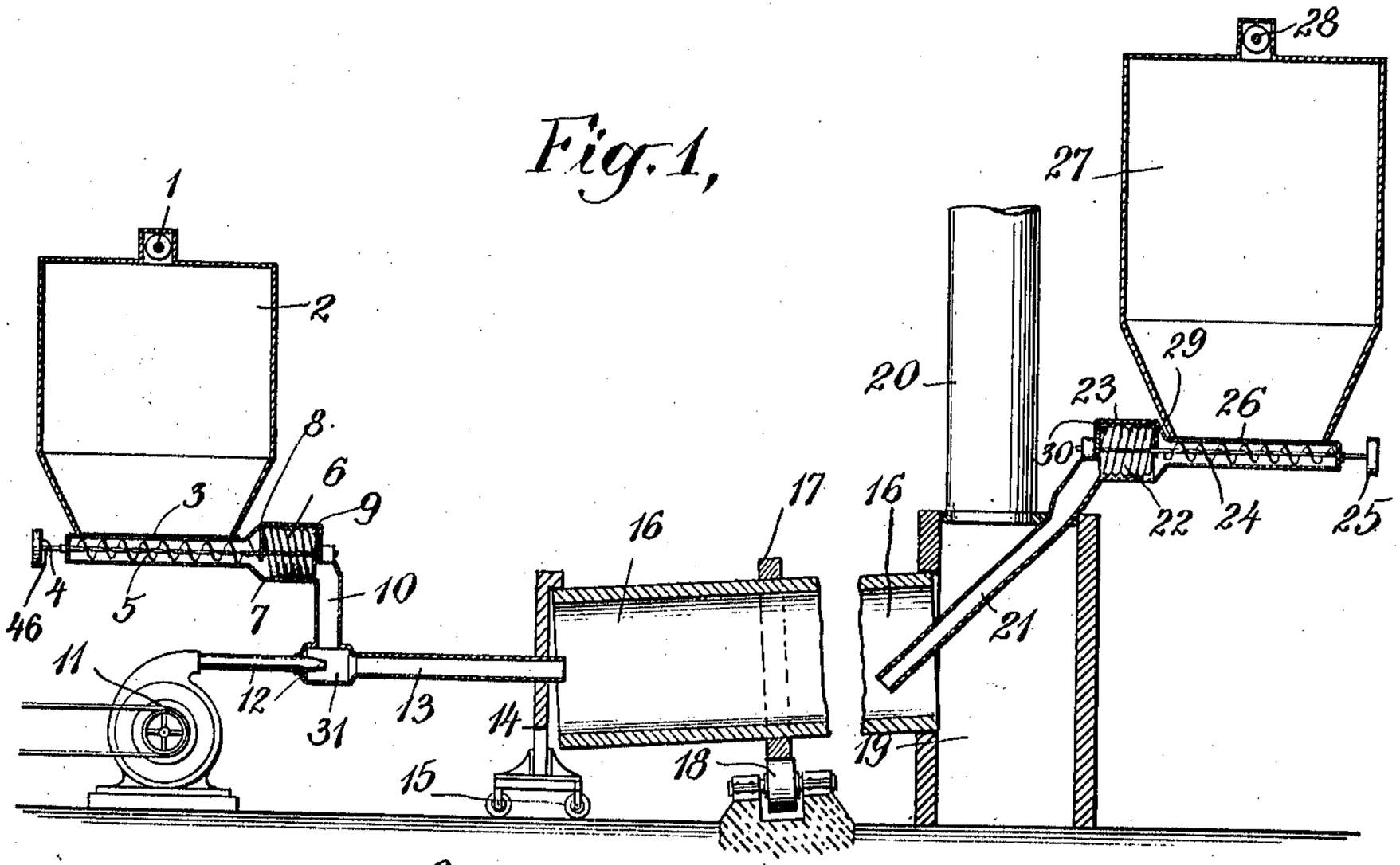


Fig. 2,

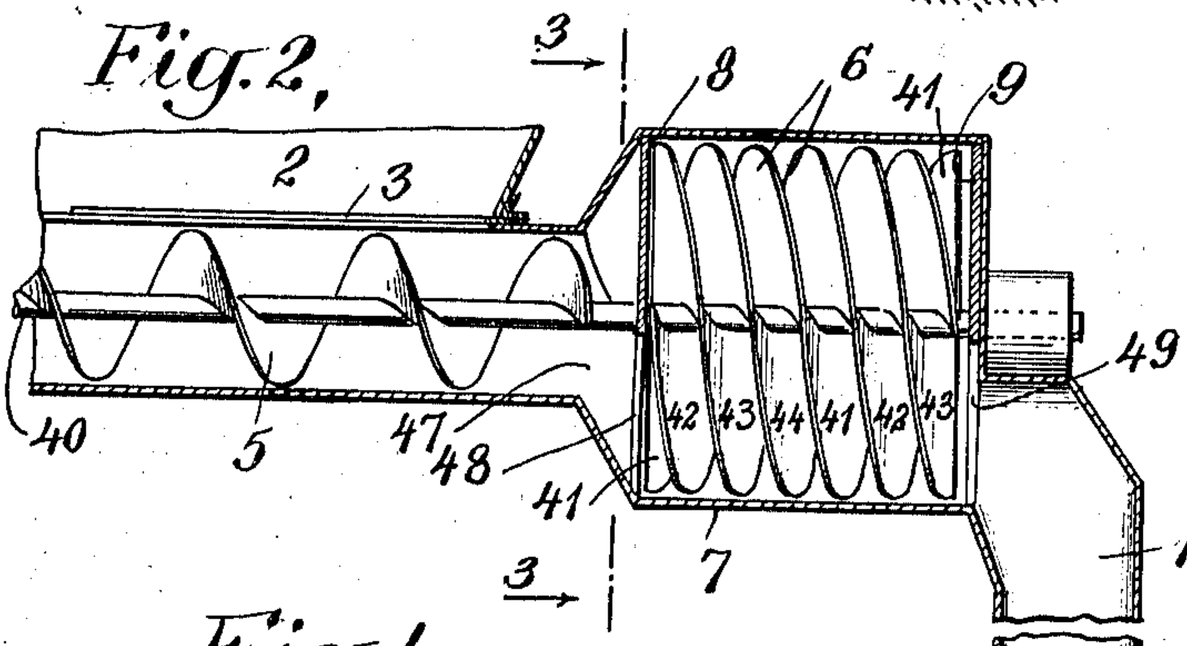


Fig. 3,

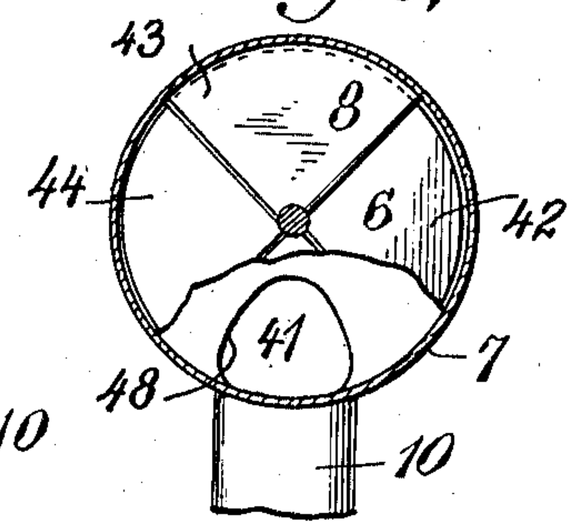
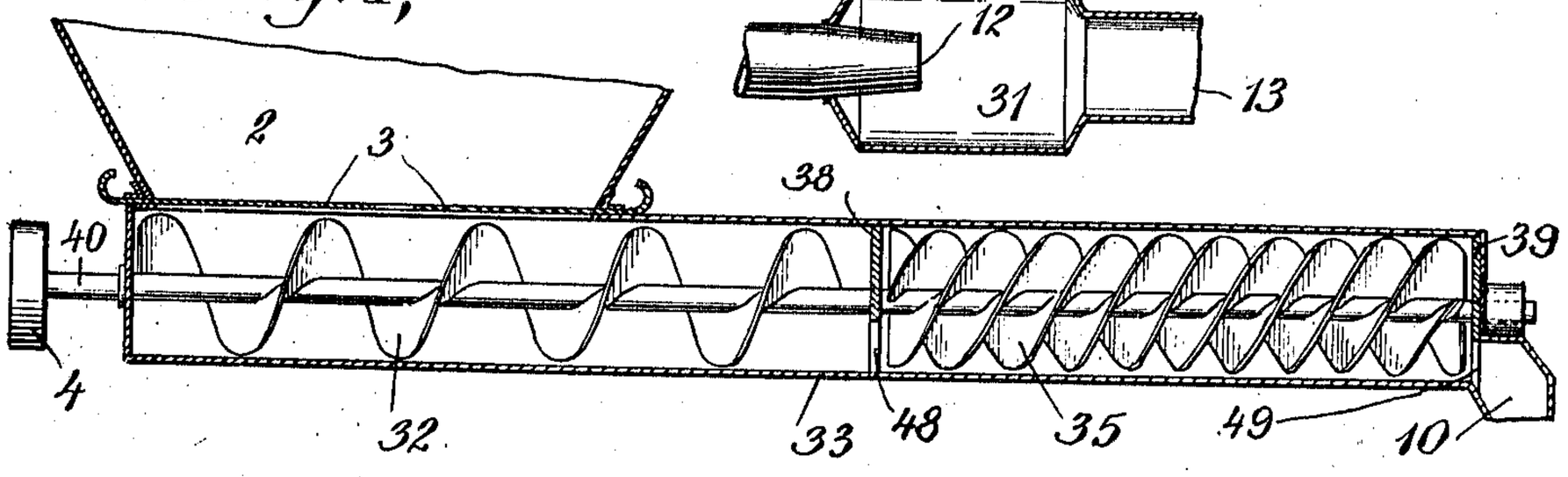


Fig. 4,



WITNESSES

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COAL-FEEDING APPARATUS FOR ROTARY CEMENT-KILNS, &c.

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To all whom it may concern:

Be it known that I, HERMAN E. KIEFER, a citizen of the United States, residing at Easton, Northampton county, Pennsylvania, have made certain new and useful Inventions Relating to Coal-Feeding Apparatus for Rotary Cement-Kilns, &c., of which the following is a specification, taken in connection with the accompanying drawings, which form part of the same.

This invention relates to rotary cement kiln apparatus for regularly and reliably feeding powdered coal fuel thereto and also, if desired, for similarly supplying the raw cement material to the kiln. This feeding apparatus may comprise a primary feeder in the form of a screw coöperating with a secondary screw feeder which may be mounted on the same shaft. The secondary feeder is provided with a plurality of flights so as to form a number of spiral feeding passages between them and the length of this secondary feeder which is mounted between cutoff plates is preferably made radically different from the pitch of its flights or a multiple thereof. The cutoff plates are formed with restricted apertures so that the spiral feeding passage communicating with the inlet aperture in the first plate is closed at its discharge end, while another passage is at that time in communication with the discharge aperture in the other cutoff plate so that it is impossible for the material to force its way or flood through this secondary conveyer and a regular feed of material is thus effected so long as the material is supplied by the primary feeder.

In the illustrative embodiment of this invention shown in the drawings, Figure 1 is a vertical section showing a coal and raw material feeder arranged in connection with a rotary cement kiln, Fig. 2 is an enlarged sectional view of the coal feeder therefor, Fig. 3 is a transverse section thereof substantially along the line 3—3 of Fig. 2, and Fig. 4 is a sectional view of a modified form of feeder.

In the illustrative embodiment of the invention shown in Figs. 1 to 3 of the drawings, the rotary kiln 16 is shown as mounted on suitable bearing rolls 18 which coöperate with the tires 17 and which may be rotated at the desired speed to give the proper speed of rotation to the kiln or this may be more positively effected in other ways. The upper end of the kiln may be connected in any desired way with the stack chamber 19 and communicating stack 20. The lower end of the kiln may be provided with a hood of any desired construction, a movable hood 14 being illustrated as mounted on the wheels 15. In the fan type of coal burning apparatus illustrated, the fan 11 may be operated by a suitable belt connection so as to supply the air through the blast pipe and nozzle 12 within the injector 31. The powdered coal fuel fed down the chute 10 is incorporated in the usual way with the impelling jet from the blast nozzle and with other air which may if desired, be admitted through openings in the injector casing, not shown, so as to form the usual fuel jet and discharge the same through the burner tube 13 into the rotary kiln to produce the luminous coal flame therein. The powdered coal may be delivered from time to time to the coal bins 2 which may have any desired form and construction by a suitable coal supply screw 1 or other feeding device, by which a sufficient amount of coal is maintained in the various bins. A suitable feeder casing 7 may be arranged at the bottom of the bin 2 and the opening between the bin and casing controlled by suitable slides such as 3 which allow sufficient coal to fall into the casing. A primary feeder of screw form may be arranged in this casing to feed forward the coal from the bin. As shown in Figs. 1 and 2, this primary feeder may comprise a shaft 40 on which one or more helical flights 5 are arranged so as to feed the coal forward when the shaft is rotated by the pulley 4 which may of course be connected with the usual variable speed operating device. The secondary feeder may, as illustrated, in this instance, be of screw form in which a plurality of flights are mounted or formed on the same shaft 40; four flights 6 having considerably greater diameter than the primary feed screw being illustrated in this instance, although of course, the number of flights may be greater or less, from three to six flights giving excellent results. These spiral flights of the secondary feeder preferably fit quite tightly within the casing 7, the clearance being considerably exaggerated in the drawings for clearness of illustration. The length of this secondary conveyer is preferably radically different from the pitch length of its flights or any multiple thereof so that for instance this secondary feed

screw may be given a length equal to one-half, one and a half or two and a half turns of its flights.

Suitable cutoff plates such as 8—9 may be mounted at either end of the secondary feeder and provided at their lower portions with constricted apertures, coöperating with only part of the spiral feeding passages between the flights. The cutoff plate 8 may for instance, be formed with the inlet aperture 48 as indicated in Fig. 3 which in the position of the feeder illustrated only communicates with the spiral feeding passage 41 so that no coal can at this time be received by the other passages 42, 43 or 44. Since the secondary conveyer has a length of one and a half turns, the feeding passage 43 in the position illustrated, is in communication with the outlet aperture 49 in the cutoff plate 9, while the feeding passage 41 at the discharge end of this conveyer is against the upper part of the cutoff plate so that it could not discharge any material, the longitudinal clearance being of course very much smaller than illustrated so as to give the tightness desired. The angular position of the restricted apertures in the cutoff plates is so arranged with respect to the length of the secondary feed screw as to prevent the discharge of material from any of the spiral feeding passages which are simultaneously receiving material through the communicating inlet aperture. It is manifest that this result can be secured by arranging the angular relation of the apertures in the two cutoff plates so that it is not necessary that the secondary conveyer shall have a length of exactly one and a half turns or the like.

The finely powdered coal fuel in the bin 2 will be received and fed forward in the casing 7 by the primary feed screw 5 so that it will slide down the inlet channel 47 and regularly pass through the inlet aperture 48 in the first cutoff plate 8 so as to enter the spiral feeding passage which is in alinement therewith. As long as the secondary feed screw rotates the powdered coal is positively and regularly fed through its casing and regularly discharged in small amounts through the outlet passage 49 in the cutoff plate 9 as each of the spiral feeding passages comes into alinement therewith. These small amounts of powdered coal fall down the chute 10 and are engaged by the initial air jet and blown into the kiln in the usual way. If, however, the coal feeder is stopped it is impossible with such a secondary feeder for the powdered coal to continue to force its way or flood through the feeder into the injector which sometimes occurs to an undesirable and even dangerous extent with some other forms of feeding apparatus. This multiple secondary screw feeder with its cooperating cutoff plates also tends to prevent any excessive feed of coal to the injector or kiln when coal is supplied to the tank or when for other causes excessive entrained air is present in the coal. It is of course understood that any reliable form of primary feeder may be used in connection with such a secondary cutoff multiple screw feeder and it is also unnecessary that the secondary feeder shall be of different diameter than the primary feeder where both are of the screw type. Such feeders may of course also be used to uniformly feed other materials in powdered condition and give desirable results when operating on the finely powdered cement material used in the dry process of making Portland cement. As illustrated in Fig. 4, a single flight feed screw 32 is mounted on the shaft 40 so as to feed such material as powdered coal or raw cement material from the bin 2 along the casing 33 and through the aperture 48 in the cutoff plate 38. The secondary feeder is in this instance of the same diameter as the primary feeder and is of the multiple flight type, four flights 35 being indicated, and the secondary feeder having a length of two and a half turns, although as previously indicated, any other uneven number of turns may be used such for instance as approximately a half turn or one and a half turn lengths. The material is uniformly discharged through the outlet aperture 49 in the cutoff plate 39 so as to descend the chute 10 and it is of course understood that the secondary feeder should fit quite tightly within its casing and cutoff plates, considerably less clearance than indicated being desirable and the tightness of fit being dependent on the material operated on and the closeness of regulation desired.

In order to secure most efficient operation it is desirable to feed the coal fuel to a rotary kiln in a positive and regular manner and also to effect a similarly reliable feed of the raw material to the kiln. In this way uniformity of the combustion and heating conditions can be maintained and fuel economized as well as minimizing danger of overheating the kiln lining or producing underburned and unreliable cement clinker. For these reasons it is desirable to have a similarly effective feeding device to control the feed of raw cement material which because of its finely powdered condition is also hard to handle and feed. The raw material bin 27 may, as illustrated, be supplied with material from time to time by the material supply screw 28. A suitable slide 26 may be arranged at the bottom of this bin to determine the access of material to the feed casing 23 which communicates at its discharge end with the conduit 21, delivering the raw cement material into the kiln. A primary screw feeder 24 may be arranged below the bin and operated by a pulley 25 on its shaft so as to feed the material to the

multiple screw secondary feeder 22 of the type illustrated in greater detail in Fig. 2. This secondary feeder 22 receives the material in the manner described into the spiral feeding passage or passages which are in alinement with the inlet aperture in the cutoff plate 29 and after feeding it through the casing discharges the material in a regular and positive manner through the outlet aperture in the cutoff plate 30 so as to give a similar regularity of feed. This raw material feeding device may of course be operated through variable speed devices so as to feed the desired amount of material to the kiln from time to time and the coal feed is of course adjusted correspondingly to give the best results. Also, if desired, the speed of kiln rotation may be effected by connected devices so that it will vary in conformity with the amount of raw material and fuel fed thereto.

Having described this invention in connection with a number of illustrative embodiments, proportions, parts and arrangements, to the details of which disclosure the invention is not of course to be limited, what is claimed as new is:

1. In rotary kiln feeding apparatus, a rotary cement kiln, a coal bin and communicating casing, a chute connected with the discharge end of said casing, an injector and burner tube connected with said chute to discharge into the kiln, a feeder shaft mounted within said casing, a primary screw feeder mounted on said shaft to feed the powdered coal delivered from said bin, a secondary four-flight feed screw of greater diameter than said primary feed screw mounted on said shaft and having a length approximately equal to one and a half of its turns and cutoff plates provided with restricted apertures at their lower portions mounted within said casing to coöperate with both ends of said secondary feed screw and prevent flooding therethrough.

2. In rotary kiln feeding apparatus, a rotary cement kiln, a coal bin and communicating casing, an injector device connected with the discharge end of said casing and with said kiln, a feeder shaft mounted within said casing, a primary screw feeder mounted on said shaft to feed forward the powdered coal delivered from said bin, a secondary multiple flight feed screw of greater diameter than said primary feed screw mounted on said shaft and having a length approximately equal to one and a half of its turns and cutoff plates provided with restricted apertures mounted within said casing to coöperate with both ends of said secondary feed screw and prevent flooding therethrough.

3. In rotary kiln feeding apparatus, a rotary cement kiln, a coal bin and communicating casing, an injector device connected with said casing and discharging into said kiln, a primary screw feeder in said casing to feed along the same the material from said bin, a secondary multiple flight feed screw having a length approximately equal to one and a half its turns and cutoff plates provided with restricted apertures in their lower portions mounted within said casing to coöperate with both ends of said secondary feed screw, and prevent flooding therethrough.

4. In furnace feeding apparatus, a furnace, a fuel bin and connected casing, an injector device connected with said casing and discharging into said furnace, a primary feeder mounted in said casing, a secondary multiple flight feed screw having a corresponding number of spiral feeding passages mounted in said casing to receive the fuel fed by said primary feeder and cutoff plates provided with restricted apertures mounted within said casing to coöperate with both ends of said secondary feed screw and cut off the discharge of the material from the feeding passages which are in communication with the inlet aperture.

5. In furnace feeding apparatus, a furnace, a fuel bin and communicating casing, an injecting device connected with said casing, and discharging into said furnace, a primary feeder, a secondary multiple feed screw having a plurality of spiral feeding passages mounted in said casing to receive fuel from said primary feeder and cutoff plates provided with restricted apertures mounted within said casing to coöperate with both ends of said secondary feed screw and prevent material passing through said spiral feeding passage independent of the movement of said secondary feed screw.

6. In furnace feeding apparatus, a bin and communicating casing, a primary feeder to feed material from said bin, a secondary multiple flight feed screw having a plurality of spiral feeding passages mounted in said casing to receive material from said primary feeder, a cutoff plate having an inlet aperture mounted in said casing at the inlet end of said secondary feed screw and a cutoff plate having a restricted outlet aperture mounted at the discharge end of said secondary feed screw to prevent discharge of material from any spiral feeding passages which are in communication with said inlet aperture.

7. In feeding apparatus, a casing, a primary feeder, a secondary multiple flight feed screw having a plurality of feeding passages mounted in said casing to receive material from said primary feeder, a cutoff plate having an inlet aperture mounted in said casing to coöperate with the inlet end of said secondary feed screw and a cutoff plate having a restricted outlet aperture mounted in said casing to coöperate with

the discharge end of said secondary feed screw and prevent simultaneous discharge of material from any feeding passage which is in communication with said inlet aperture.

8. In feeding apparatus, a casing, a primary feeder in said casing, a secondary multiple flight feed screw having a plurality of spiral feeding passages mounted in an enlarged portion of said casing and cutoff plates provided with restricted apertures in said casing, coöperating with both ends of said secondary feed screw to prevent the discharge of material from any feeding passage thereof which is simultaneously receiving material.

9. In feeding apparatus, a casing, a primary feed screw in said casing, a secondary multiple flight feed screw having a plurality of spiral feeding passages mounted in said casing and having a larger diameter than said primary feed screw, a cutoff plate having a restricted inlet aperture mounted to coöperate with the inlet end of said secondary feed screw, there being an inclined inlet channel leading from said primary feed screw to said inlet aperture and a cutoff plate having a restricted outlet aperture mounted to coöperate with the discharge end of said secondary feed screw to prevent the simultaneous discharge of material from any passage which is in communication with said inlet aperture.

10. In feeding apparatus, a casing, a shaft mounted in said casing, a primary feed screw on said shaft, a secondary feed screw having a plurality of spiral feeding passages mounted on said shaft, a cutoff plate having a restricted inlet aperture coöperating with the inlet end of said secondary feed screw and a cutoff plate having a restricted outlet aperture coöperating with the discharge end of said secondary feed screw to prevent the simultaneous discharge of material from any feeding passage which is in communication with said inlet aperture.

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Witnesses:
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