This invention relates to improvements in mills for grinding grain, and especially to those for grinding coffee berries. In mechanism hitherto proposed for grinding grain, including coffee grinders, a plurality of sets of crushing elements, for breaking and grinding the grain, respectively, have been provided, and these sets of elements have had connection with each other, so that the grain to be crushed is fed first to one of said sets of elements, where it is broken or coarsely ground and then passes to the other set of elements where it is more finely ground. In these mechanisms it also has been proposed to remove the chaff, dust and dirt from the grain intermediate the two crushing operations, by subjecting the grain to the action of an air current of such strength that it will carry off the chaff and lighter particles and allow the heavier particles to pass to the second set of crushing elements.

One of the important objects of this invention is to improve mechanism of the kind hereinbefore stated by so combining and correlating the parts as to have important advantages not inherent in the prior devices while preserving any valuable feature which is present therein.

Another important object of the invention is to provide an improved correlation of parts whereby a current of air of less strength than otherwise would be required will be adequate to effect a withdrawal of the impurities from the grain.

Another important purpose of the invention is

to provide a grinding mechanism wherein the grain may be subjected to the action of a set of crushing elements and conveyed thence to and be acted upon by a second set of crushing elements, or may be acted upon by the second set only, at will. This object is secured by providing separate feeders, so correlated with the sets of crushing elements respectively that the grain supplied from one feeder will be subjected to the action of both sets of crushing elements, while the grain supplied from the other feeder will be subjected to the action of the second set of crushing elements only.

A fourth important purpose of the invention is to provide a mill in which at the will of the operator the grain may (1) be preliminarily coarsely crushed or broken by a set of crushers or breakers, the impurities separated therefrom and the cleaned or purified grain more finely crushed by a second set of crushers, or (2) may be ground only. This object is secured by providing a first and a second set of crushers producing different degrees of fineness of grind, a conveyer for transferring the grain from one to the other, a separating means operable upon the grain in its passage from the first set to the second, and separate feeders of unground grain respectively connected with the sets of crushers.

A further important purpose of the invention is to provide a grinding mill having a conveyer and crushing elements, with means whereby the ill effects accruing from the conveying of the grain to the crushing elements at a faster rate than the crushing elements will accommodate are automatically overcome. This purpose is secured

by providing a chamber so correlated with the conveyer and crushing elements fed by the latter that it will accommodate grain fed in excess of the capacity of the crushing element and will automatically return the grain when the crushing elements are capable of taking care of the same.

Another important purpose of the invention is to provide a mill having means of most practical, simple and beneficial nature for attaining all of the aforesaid objects.

In the accompanying drawings, I have illustrated the preferred embodiment of the invention when applied to the cleaning and grinding of coffee, but I would have it understood that this embodiment is merely exemplary and that changes in the details may be made without departing from the spirit of the invention or the scope of the subjoined claims. In said drawings, wherein like characters of reference are used to designate corresponding parts in the several views:-

Fig. 1 is a longitudinal vertical section taken centrally through a coffee mill embodying the improvements, with certain parts in elevation;

Fig. 2 is a vertical transverse section on line 2-2 of Fig. 1, looking in the direction of arrow a;

Fig. 3 is a vertical transverse section line 3-3, looking in the direction of the arrow b;

Fig. 4 is a detail perspective view of the head of the suction conduit, showing the lateral enlargement

thereof and the prolonged opening therein.

The frame or casing of the present mill is suitably formed to provide the first crusher chamber A, a second crusher chamber B, a conduit C leading from the first crusher chamber, a passageway D leading from the conduit to the second crusher chamber, a chamber E opposite the second crusher chamber B, and a space F below the passageway D and between the chamber B and E. The passageway D is in open communication at one end with the conduit C and at the other end with the chamber B, the latter communication being preferably provided through a downwardly extending spout 20 from the passageway entering a funnel-shaped inlet 21 at the upper end of the chamber B.

In the space F there is mounted a motor, whose casing indicated at G, has a base G' which in practice preferably constitutes the base of the mill casing. This motor is preferably of an electrical nature. It is directly connected to a shaft H, one end of which is directly connected to and drives a fan I, and the other end of which is directly connected to and drives the runner burr 22 forming one of the crushing elements in the chamber B.

In this particular exemplification of the invention, the crushing elements in the chamber A are of a nature such as to break the grain - that is to say, they are, in the present exemplification and preferably, composed of a rotative breaker drum 25, which cooperates with a suitable companion element 26 which is located at one side of the axis of the drum and is preferably roughened. It will be

noted that this element substantially forms one wall of the chamber and is eccentric to the axis of the drum. The crushing elements in the chamber B may be of any suitable construction. They are here shown as being of a grinding nature, comprising the hereinbefore mentioned runner burr 22 and a stationary burr 23 having serrated or roughened confronting faces. These grinders in practice should include appropriate means whereby the motion of the runner burr is automatically stopped when a hard foreign substance gets between the burrs. A desirable construction of grinding mechanism for the chamber B is shown and described in my U. S. copending application, filed July 14,1915, Serial No. 39,820, to which reference may be had for a further understanding relative thereto.

J designates a movable conveyer for transmitting grain which has been partially treated in the first crusher chamber A to the second crusher chamber B, This conveyer is preferably of the worm type, as here shown. The shaft H is connected by any suitable means,-as a train of gears 27, 28 and 29, for example - with the shafts 30 and 31 of the conveyer J and breaker drum 25, respectively.

K designates a feeding chamber which is suitably connected to the crusher chamber A and supplies the grain to the latter. This feeder may be of any suitable nature, but preferably is formed with converging sides 32 and 33 extending from the top to the bottom thereof and opening at the lower reduced end of the feeder into the chamber A, at a place which is eccentric to the axis of the drum 25.

L designates an air conduit which extends from

the fan chamber E to the conduit C. This conduit C has an opening 34 in one of its walls, through which it has communication with the conduit L, and the conduit L preferably has adjacent the said opening a laterally expanded head 35 with an opening 36 throughout its length, the opening 34 in the conduit C in such case being long, as shown best in Fig. 3. In other words, it is preferred to form the opening 34 substantially entirely across one wall of the conduit C and to provide the conduit L with a laterally expanded end having an opening co-extensive in length with the opening 34. A downwardly inclined spout 37 is preferably provided within the conduit C. This spout extends from the opening 34 and forms a baffle in the path of the crushed grain, falling from the chamber. The grain falls thence upon another baffle 38. The latter is disposed between the end of the spout and an air opening 39 formed in a wall of the conduit. The baffle 38 is arranged to discharge upon another baffle, 40, which extends to the chamber D and is inclined in a direction opposite to that of the baffle 38. An additional air opening, 41, is preferably provided in the wall of the conduit C below the spout 37 and in the space separating the baffles 38 and 40. The air openings 39 and 41 are preferably independently regulated by valves 42 and 43 of suitable kind.

Thus it will be seen that when the fan I is in motion it will create a current of air which will pass from the opening 39 around the discharge end of the baffle 38 and thence upward and into the spout 37 and to the opening

34, through which opening it will flow to the fan casing E, through the conduit L. This current of air carries with it the chaff, dust and dirt - that is, the impurities - which have been freed from the grain by the set of breaking elements 25 and 26, and the air, together with the impurities therein, is discharged into the fan chamber E, and finally from the latter through an outlet 44' preferably into a suitable container, not shnwn. It will be understood that the partially treated grain is spread out in its travel along the baffle 38 and is discharged from the latter in a thin sheet, and it will be noted that the correlation of the openings 39 and 41 with the space between the discharge end of the baffle 38 and the baffle 40 is such that the air passes through this thin sheet of falling grain in a direction which is at an angle to the direction of movement of the grain instead of in a direction which is parallel to the movement of the grain. The baffles thus direct the air currentsin particular defined paths through the falling grains, so that the separation of the impurities from the grain is effectively accomplished by a current of air of less strength than otherwise would be required, and there is less danger of the current of air carrying off grain as well as impurities; and, moreover, the impact to which the grain is subjected in falling from one baffle to another loosens any chaff etc. which may be adhering to the larger particles of the grain, whereby the withdrawal of the chaff etc. is facilitated. Again, it will be noted that the provision

of two separate and independently regulatable air inlet openings affords provision for the subjecting of the broken grain to the action of either one or both of two separate currents of air of independently regulatable strengths at different places in the travel of the grain. When the inlets are arranged in the particular relation to the baffles and outlet spout shown in the accompanying drawings, the grain in its travel upon the baffle 38 and between the upper wall of the spout and said baffle, is subjected to a current of air which removes the impurities which are upon the surface thereof and in its travel between the baffle 38 and the baffle 40 is subjected to another current of air which removes the remaining impurities.

Obviously, the grain which has been thus broken and separated from its impurities is delivered to the conveyer J, and is conducted by said conveyer and discharged into the second chamber B, wherein it is subjected to the action of the second set of crushing elements - namely, the runner burr 22 and the stationary burr 23. These burrs are relatively adjustable to grind to various degrees of fineness, as usual. The purified and ground grain is discharged from the chamber B, in the herein exemplified form of the invention, through an outlet 45' and into a suitable container, not shown.

An important part of the present invention consists as already implied, in the provision of means whereby the grain may be ground in the chamber B without being preliminarily crushed in the chamber A or purified in the con-

duit C. To this end, the passageway D has communication with a second feeder chamber, marked M. This second feeder chamber opens at its lower end into the portion of the passageway D situated after that portion of the passageway which opens into the conduit C. Hence, it will be noted that grain may be supplied through the feeder chamber M and will reach the crusher chamber B without first passing through the chamber A or the conduit C. Another of the important features hereinbefore referred to has reference particularly to the prevention of the ill effects which would occur from the feeding of grain to the chamber B faster than the set of crushing elements in the latter is capable of grinding the same, or at a time or in quantity which would result in the clogging of the action of the second set of crushing elements. It will be noted that in the form of the invention herein illustrated, the feeder chamber M is disposed immediately above and is in open communication with one end of the passageway D. Hence, this chamber M not only serves as a feeder for grain, which is not to be subjected to the action of the first set of crushing elements and to the purifying action of the air current, but also serves, when the grain is beingfed from the feeder K, and hence is being subjected to action of the first set of crushing elements and to the purifying action of the air currents, as an upper enlargement of the discharge end of the passageway D into which any grain fed in excess of the capacity of the crushing elements in the chamber B is automatically forced and flows gravitally back into said passageway to be delivered thence to the

chamber B, when the quantity fed is below the capacity of the crushing elements in the latter. In other words, it serves at times as a feeder for grain which is not to be subjected to the action of the first set of crushing elements or purified and at other times it serves to receive from the passage D an excess of grain and thereby overcomes the ill effects which would follow congestion or clogging of grain in the discharge end of the latter, or in the chamber B.

It is apparent that when the grinding elements in the chamber B are relatively adjusted to pulverize the grain they will not take care of the grain as rapidly as when they merely granulate the same and hence in a machine intended to either granulate or to pulverize at will, it is desirable to regulate the feed of the grain to the breaker elements in the chamber A to thereby overcome any possibility of the broken grain overflowing the chamber M. To this end, a valve of any suitable nature which will regulate the supply of grain to the chamber A is employed. One such valve-- the same being slidably mounted at the outlet from the feeder chamber K - is shown at 45 in Fig. 3. This valve has an opening 44 and by its adjustment variably regulates the extent of the communication of the feeder chamber K with the chamber A, as is apparent. The inlet 21 to the chamber B similarly is provided with a suitable valve, as the one shown at 46, which is adjustable to close said inlet completely, or to open it either fully or partially as required. The valve 46 which I prefer is a slidably mounted plate having an opening 46'.

The operation and advantages of the structure will be apparent from the foregoing description, and it will be understood that the form herein illustrated is merely exemplary and that changes may be made in the number or character of sets of crushing elements and in other details without departing from the spirit of the invention or the scope of the subjoined claims. While I have herein referred to a first set of crushing elements and a second set of crushing elements, each having a feeding chamber separate from the other, it of course will be understood that it is quite within the spirit of the invention to provide any suitable number of steps in such crushing elements and to provide all or certain of the same only, with their separate feeding chambers. Hence, the terms, first crusher chamber or set of first crushing elements, or second crusher chamber or set of second crushing elements are intended to be construed broadly, being merely employed as a convenient way to distinguish one of said chambers and its crushing devices from another.

I have before referred to the ill effects which occur from the feeding of grain to the chamber B faster than the set of crushing elements of the latter is capable of grinding the same or at a time or in quantity which would result in the clogging of the action of the second set of crushing elements. It will be understood that there may be several causes in the operation of the mill which render it advisable to temporarily discharge a part or all of the grain into the overflow chamber formed by the feeder M, and among these there may be mentioned a

failure of the grinding elements in the chamber B to operate for a short period or a choking of said grinding elements due to foreign substances. In any of these events, the coffee passing to the grinding elements would be forced upward into the feeder M. These causes, and any other cause which makes it advisable temporarily to supply grain to the overflow chamber are all intended to be included in the expression to the effect that said chamber receives grain which is fed faster than the capacity of the grinding elements.

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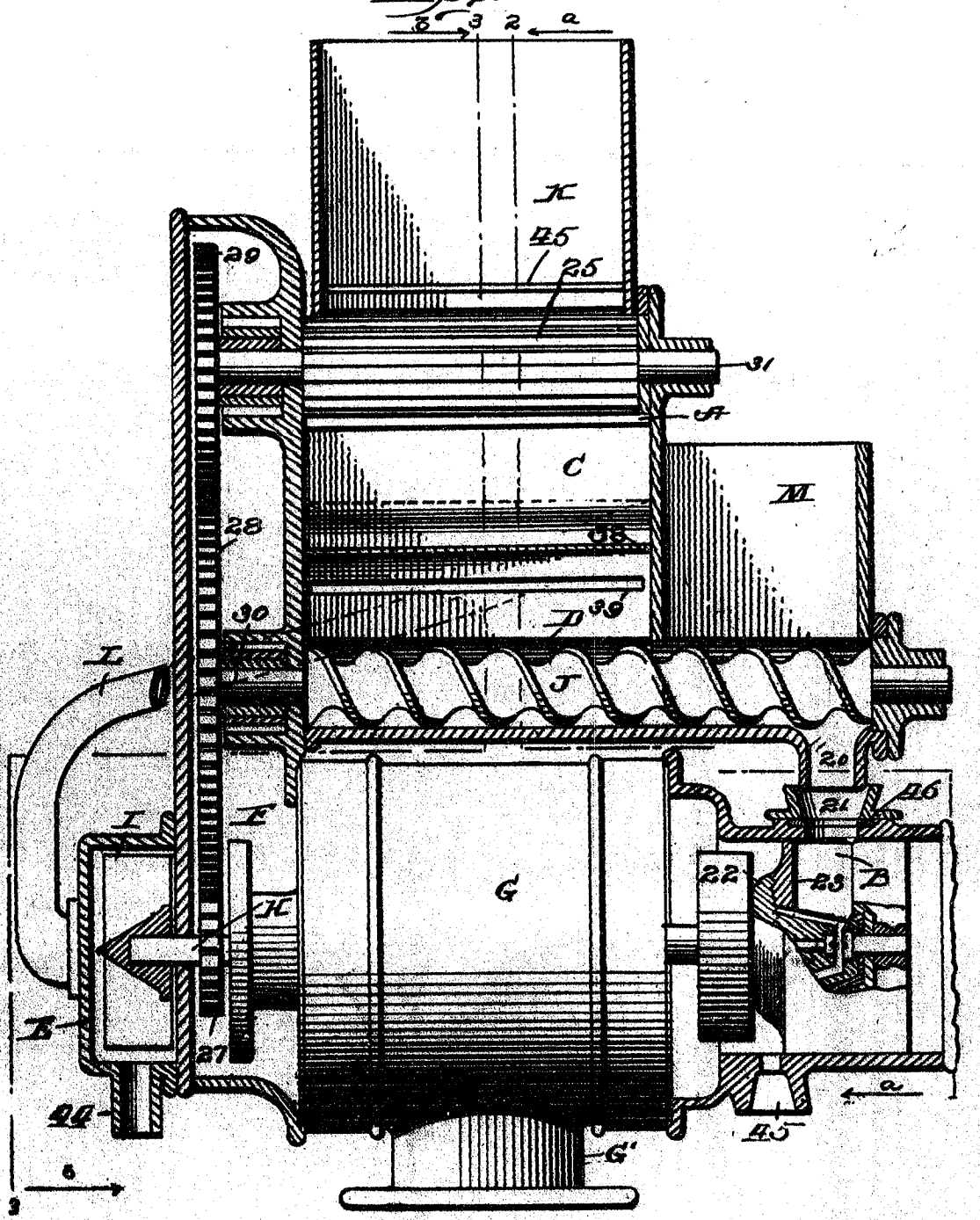
Fig. 1.



Certified to be the drawing referred to in the specification hereunto annexed.

New York, June 6, 192

APPLICANT

International Business Machines Corporation

Assignee for Barnard M. Ely

Cooper, Kerr & Dunham

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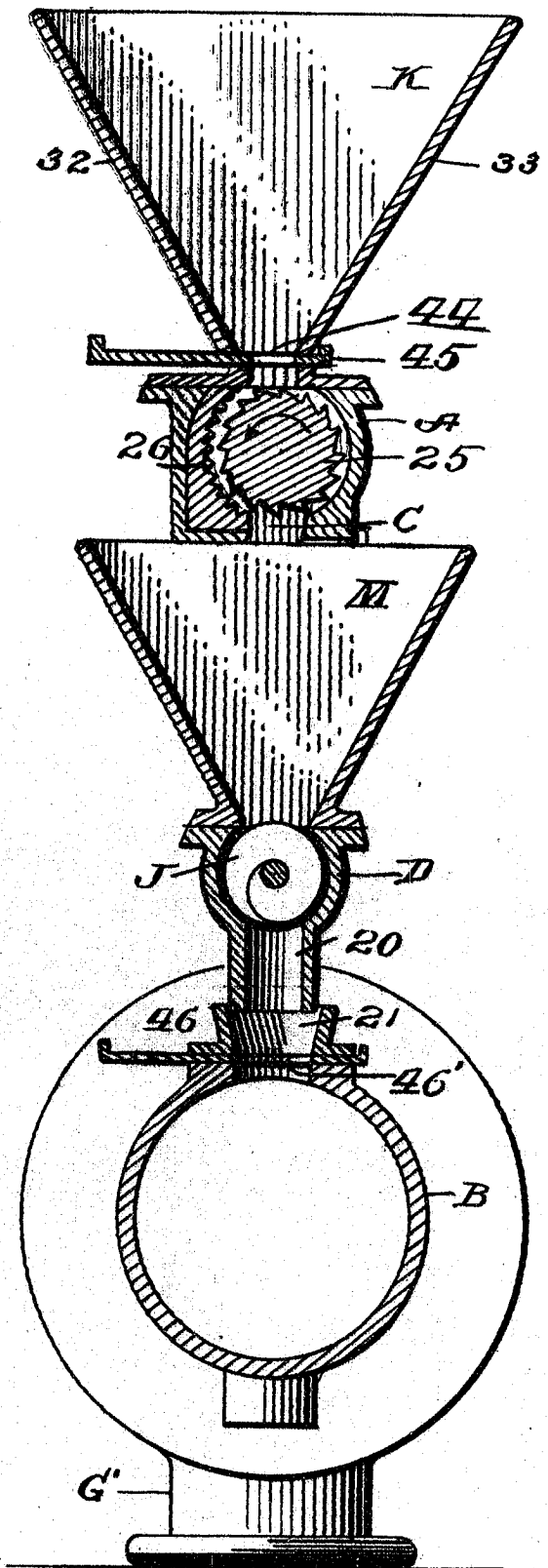
Fig. 2.



Certified to be the drawing referred to in the specification hereunto annexed.

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Assignee of Bernard M. Fly.
Cooper, Kerr & Dunham
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Fig. 3.

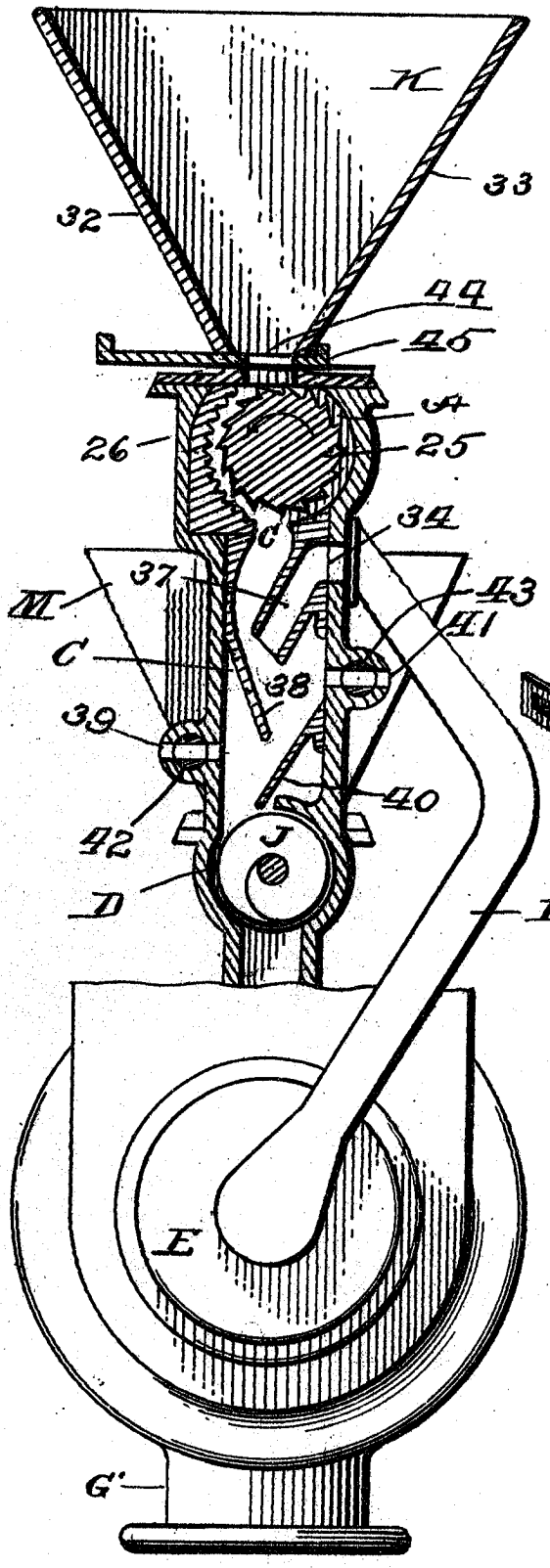
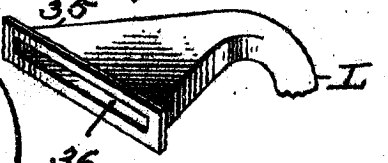


Fig. 4.



Certified to be the drawing S *referred to in the specification hereunto annexed.*

New York, June 6, 1924

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