

No. 755,016.

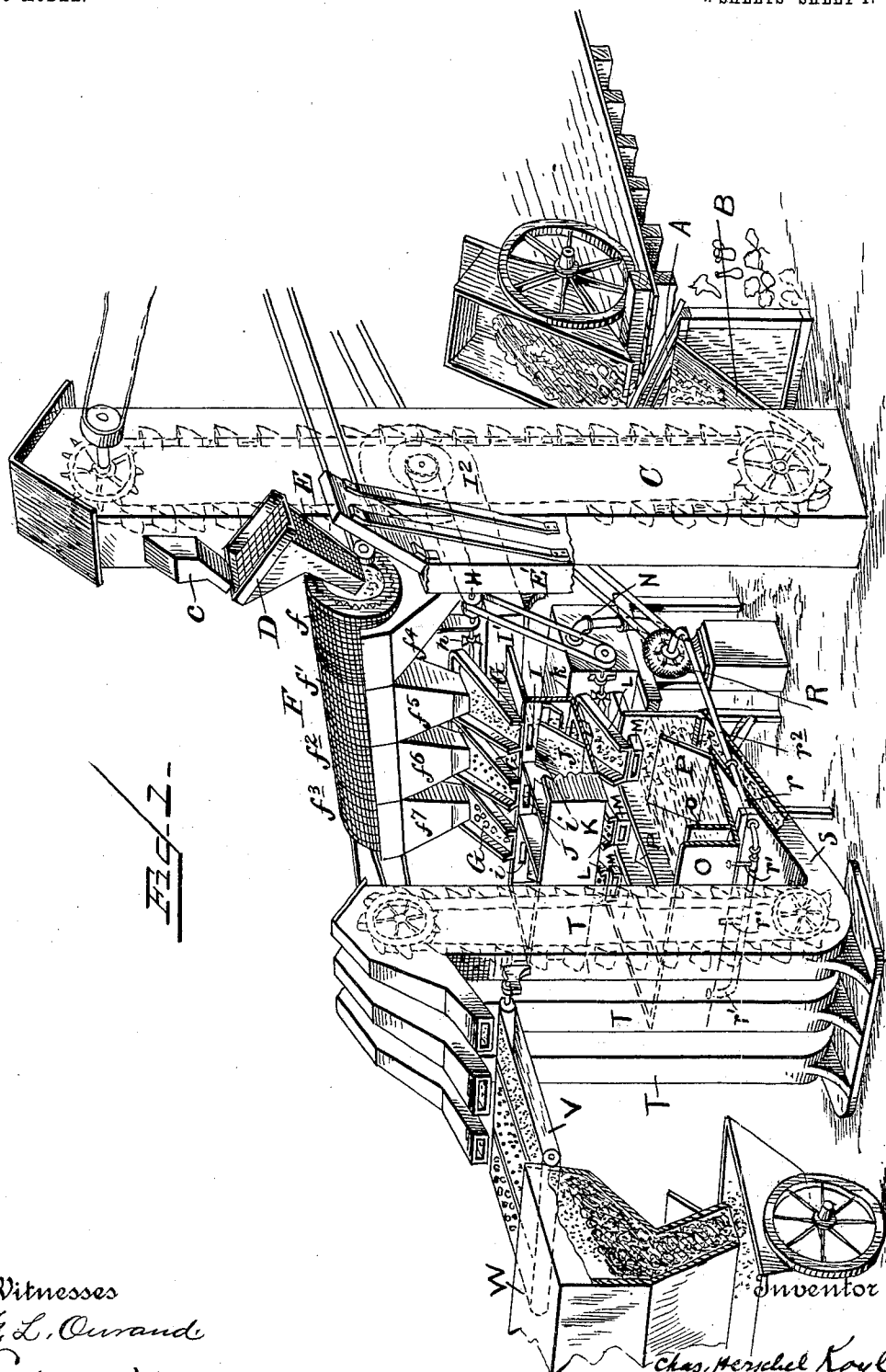
PATENTED MAR. 22, 1904.

C. H. KOYL.
COAL SEPARATING APPARATUS.

APPLICATION FILED JUNE 8, 1903.

NO MODEL.

3 SHEETS—SHEET 1.



Witnesses
F. L. Curande
Edwards

Inventor
Chas. Herschel Koyle
by Maurus Bailor
Attorney

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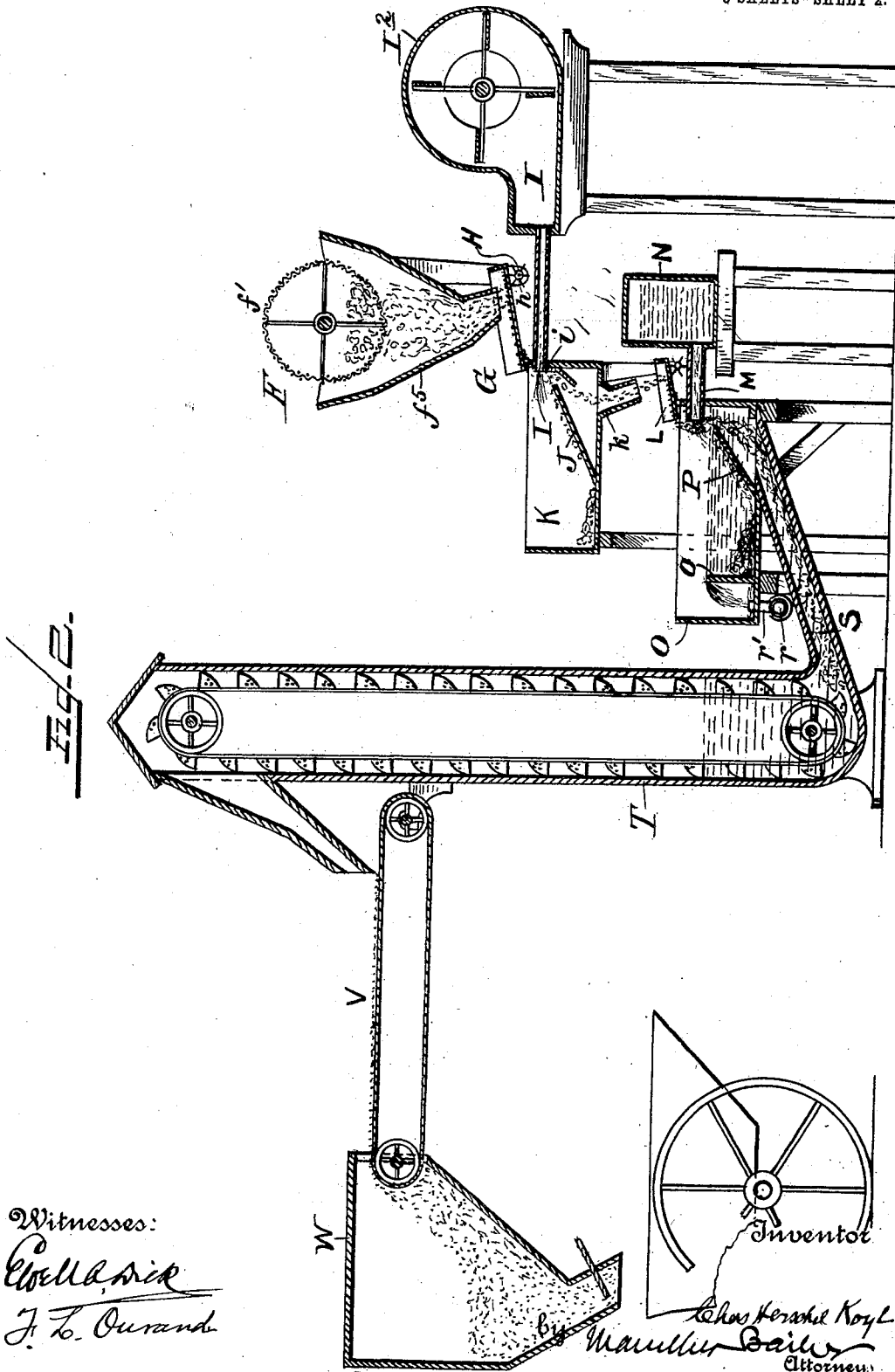
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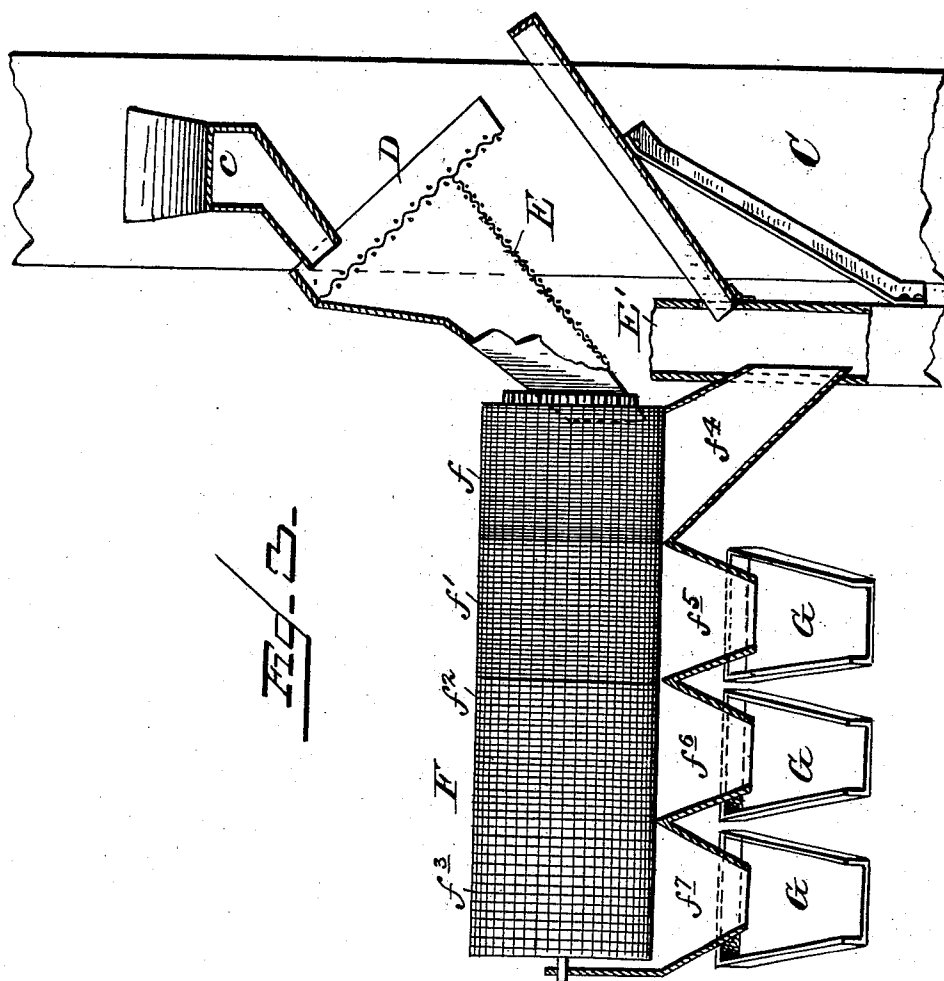
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3 SHEETS—SHEET 3.



Witnesses
F. L. Ouraud.
E. W. Dick.

Inventor
Charles Henschel Koyle
by Marshall Bailey
Attorney

UNITED STATES PATENT OFFICE.

CHARLES HERSCHEL KOYL, OF NEW YORK, N. Y.

COAL-SEPARATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 755,016, dated March 22, 1904.

Application filed June 8, 1903. Serial No. 160,656. (No model.)

To all whom it may concern:

Be it known that I, CHARLES HERSCHEL KOYL, of the city of New York, in the county and State of New York, have invented certain new and useful Improvements in Coal-Separating Apparatus, of which the following is a specification.

My invention has to do with the mechanical separation of coal from furnace and household ashes and other refuse with which the same may be mixed. Its principal characteristic is that the charge to be operated on after having had separated from it the fine ash, and also to a great extent pieces of refuse larger than the pieces of coal, is subjected while moving in a thinly-distributed stream to the action of a current of air and a current of water successively, whereby the solids of different specific gravity—such as slate, stone, clinker—will be separated out from the coal, leaving the latter finally to a great extent clean and free from refuse.

In the accompanying drawings I have represented a working plant adapted to effectuate my invention.

In the drawings, Figure 1 is a perspective view of the complete apparatus. Fig. 2 is a longitudinal vertical section of the same. Fig. 3 is an enlarged sectional detail view illustrative of the rotating assorting-sieve and the parts more immediately associated therewith.

The plant illustrated in the drawings consists of the following parts: A coarse screen A (upon which the cart dumps its load) is provided for the separation of cans, paper, rags, and other large rubbish, which to a small extent are mixed with household ashes. Beneath this screen is a hopper B, which catches all the material—ashes, slate, clinkers, and coal—that falls through the screen and conducts it to an elevator C, which carries the material to the top of the building in a continuous stream, whence it is delivered through a chute *c* onto a screen D for separating out from the charge masses of clinker larger than any pieces of coal. Below screen D is a screen E (onto which falls the material that passes through screen D) for separating out the fine ash from the charge. The refuse from D and E discharges into a chute E', which carries it

off to any point desired. By these preliminary steps the large rubbish and pieces of refuse, as well as the fine ash, have been separated out from the mass, leaving a mass in which the coal is mixed with bits of clinker, slate, and other refuse of a size not larger than the largest pieces of coal. It remains to separate out the coal from this refuse. This I accomplish by subjecting the mixed material to the action of strong currents of air and of water successively in the manner which will be presently described; but in order to grade the material, as well as to render more effective the action of the air and water blasts or currents, I prefer to preliminarily assort the charge into different grades or sizes—say one size being that of pea-coal, the next nut-coal, and the next egg-coal—or approximate sizes. This can be attained by passing the material over screens (whether stationary or movable) of suitable mesh. I prefer to use for this purpose a power-driven inclined rotary screen F, into the higher end of which is discharged the material which passes over the screen E. This rotary screen is divided into four sections. The first section *f* has a fine mesh, like E, to assure the separating out of any fine ash which may have passed over E. The second section, *f'*, is graded for, say, pea-coal, and through it pass the bits of coal and refuse—such as slate, clinker, &c.—of that size. The next section, *f''*, is graded for nut-coal, and the last section, *f'''*, is graded for egg-coal. Each section has its own separate and distinct hopper *f⁴* *f⁵* *f⁶* *f⁷*, respectively, into which it discharges the fine ash, hopper *f⁴* leading into the refuse-chute E'. The charge is thus separated into a number of distinct subdivisions. These subdivisions remain distinct and separate from one another during subsequent treatment, and the pieces, whether coal or clinker, &c., which make up any one subdivision are all approximately of a size.

Below each hopper *f⁵* *f⁶* *f⁷* is an inclined feeding plate or shelf G, (preferably of sheet-steel,) down which passes the material discharged from the hopper above. The shelf is attached (by hinge or otherwise) at its lower end to a suitable support, and it is designed to be vertically vibrated or shaken, for which

purpose it can rest at its upper end upon a series of radial knockers *h* upon a power-driven rotary shaft H. Directly below the front end of each feed plate or shelf G is a long narrow horizontal slit *i* of a length equal to the width of the discharge end of the feed-plate and constituting the mouth or discharge-orifice of a nozzle I, leading from an air-reservoir I', containing air under pressure supplied to it by an air-blower I². The front edge of the feed-plate is directly at and over the discharge-slit, so that the pieces of coal, &c., passing over the front edge of the feed-plate will drop with minimum velocity upon the horizontal stream of air under pressure issuing from the horizontal slit in the nozzle below. The angle of inclination of the feeding-plate should be little, so that the descent of the pieces thereon shall be comparatively slow. This, coupled with the vibrating movement of the feed-plate, insures the gradual but uniform descent of the pieces and causes them to progress side by side and not one above another, all of which conditions conduce to the more perfect separating action of the air-blast. This air-blast serves to separate out from the mass the lighter bits of refuse. The air issues from the slit in a wide shallow stream of predetermined pressure and speed, and upon it is delivered from the feed-plate above the thin regulated stream of mixed pieces of coal, clinker, slate, &c. The pieces of greater specific gravity, such as coal and hard clinker, fall through the stream of air with but slight deflection from their course; but the lighter pieces are deflected much more by the air-current and are carried thereby beyond a partition J, set up at a suitable point for the purpose of separating these lighter pieces from those of greater specific gravity. This partition is in the present instance set up in inclined position in a box K. The light clinker, &c., is carried over into that part of the box beyond the partition, while the coal and hard clinker drop on the other side of the partition and are carried off through a discharge-chute *k*. Below this chute *k* are a series of vibratory feed-plates L and nozzles M, which are the same in construction and arrangement as the feed-plate G and nozzles I, already described, the difference being that the nozzles M discharge streams of water of predetermined pressure and speed instead of streams of air. The nozzles get their water-supply from the water-reservoir N, with which they are connected. With each nozzle M and its feed-plate L is associated a box O, having a partition P, similar in function to the partition J in the light-clinker box K above. R is a rotary power-driven pump which takes water from the several boxes O through pipe *r* and branches *r'* and returns it to the reservoir N through pipe *r*². There is in each box O a vertical wall *o* between the partition P and the far side or outer wall of the box. The space between

this wall and the adjoining side of the box, into which space the appropriate branch pipe *r'* enters, forms a downpour for the water from the box.

The action of the horizontal stream of water issuing from each nozzle upon the pieces dropping on it from above is to permit the coal, which is of greater specific gravity, to pass down without material deflection upon the near side of the partition P, but to deflect to the far side of the partition the hard clinker and stone, which while of greater specific gravity than the light clinker separated out by the previous operation is of less specific gravity than the coal. In this way I obtain a body of coal which is almost entirely free from stone, clinker, and other foreign substance and is also washed and clean.

From the box O the coal passes by chutes S to the elevator T with perforated buckets, which deliver it to the picking-belts V, where boys may glean the few remaining bits of foreign substances now washed and easily seen. From the picking-belts the coal is delivered to storage-bins W or other suitable receptacles.

It will be understood that at the various points in the apparatus where refuse may accumulate suitable means for discharging and carrying off the same should be provided.

The nozzles both for the air and the water will of course be provided each with individual means for regulating the speed and pressure of the discharge therefrom.

In that portion of the apparatus in which water is used the coal and refuse bins should be water-tight, so that the stream of water shall be merely a surface current, and to prevent eddies the top of the wall *o*, over which the water rises from the bin, should be below the lower edge of the discharge-slit in the nozzle—that is to say, should be in a plane slightly below the plane of the bottom of the discharge-slit in the nozzle. The wall *o* is, in fact, a dam, which not only determines the height of the water in box O, but serves also to keep back refuse from passing over into the downpour.

Each vibrating feed-shaft G has a discharge-mouth equal in width to the slit in the fluid-discharge nozzle below. In practice the shelf is caused to make, say, thirty vibrations a second. The angle of inclination at which the shelf is set is not steep, but is of such comparatively slight inclination that the pieces of coal, &c., which rest upon it will not slide down until vibration begins. In this way the material when acted on is discharged from the shelf upon the fluid-stream below in a path at a very slight inclination to the direction of travel of the same, the result being that the work of separation is very efficiently accomplished. This feature is of material value, whether the separating fluid employed be water or air. I prefer, however, the use of both

of the last-named agents successively. By means of the air the light clinker (which is in substance nothing but fine ash not yet broken up) is easily removed from the mass of material, leaving for the water separation only the heavy (or real) clinker and coal, which two substances are of nearly the same specific gravity. The air is used first, because it takes out practically all of the dust and other light material, which if allowed to remain would float on the water and would soon foul the water to such an extent that its repeated use could not long be continued. The water is used afterward, because its specific gravity fits it for the separation of pieces of coal and clinker (which latter is somewhat porous) during the moment when the clinker-holes are still filled with air and before they have filled with water, during which moment the coal drops on the near side of the partition P and the clinker is floated over to the far side of the latter, immediately after which the clinker sinks. I use the water last because practically the last step in the process is the washing of the coal, and this is also effected by the water.

Having described my improvements and the best way now known to me of carrying the same into effect, what I claim herein as new and of my own invention is as follows:

1. In an apparatus for separating coal from clinker and other refuse, the combination of the following instrumentalities viz: a substantially horizontal nozzle terminating in a wide, shallow, substantially horizontal discharge-mouth from which the fluid will issue in a wide shallow horizontal stream; means for supplying fluid under pressure to said nozzle; a vibrating feed-shelf having a discharge-mouth of a width substantially the same as that of the fluid-discharge mouth and arranged immediately above the latter so that the material passing from the shelf will be delivered upon the surface of the stream of fluid below, the shelf being set at a slight rearward inclination relatively to the nozzle; means for vibrating the shelf; a receptacle below, and a partition in said receptacle to one side or the other of which the different components of the mass under treatment will pass according to their different specific gravities, substantially as and for the purpose hereinbefore set forth.

2. In apparatus for separating coal from clinker and other refuse, the combination of the following instrumentalities viz: a substan-

tially horizontal air-nozzle terminating in a wide shallow mouth from which the air will issue in a wide shallow horizontal stream; means for supplying air under pressure to said nozzle; a vibrating feed-shelf having a discharge-mouth of the same width with that of the air-nozzle and arranged immediately above and at a slight rearward inclination relatively to the nozzle; a receptacle below and a partition in the receptacle to one side or the other of which the different components of the mass under treatment will pass according to their specific gravities; a second vibrating feed-shelf arranged below and to communicate with that compartment of the receptacle above containing the mixed clinker and coal resulting from the air-separating operation; a substantially horizontal water-nozzle with a wide shallow discharge-mouth, arranged immediately below the discharge end of the screen, the latter being set at a slight rearward inclination relatively to the nozzle so that the mixed coal and clinker from the screen shall be launched upon, rather than dropped into the stream of water issuing from the nozzle; means for supplying water under pressure to said nozzle; and means for carrying off the clinker separated out from the coal by the action of the water, substantially as hereinbefore set forth.

3. In apparatus for separating coal from clinker and other refuse, the combination of the following instrumentalities viz: a nozzle terminating in a wide, shallow horizontal discharge-mouth; means for supplying water under pressure to said nozzle; means for feeding upon the surface of the wide, shallow stream of water issuing from said nozzle, the material to be acted on; a water-tight receptacle below divided by a partition with two bins, into one or the other of which the different components of the mass under treatment will pass according to their different specific gravities; and a wall or dam over which the water passes from the receptacle having its top in a plane slightly below the plane of the bottom of the discharge-mouth in the nozzle, substantially as and for the purpose set forth.

In testimony whereof I have hereunto set my hand this 2d day of June, 1903.

CHARLES HERSCHEL KOYL.

Witnesses:

H. STERN,

CHAS. A. HAMMOND.