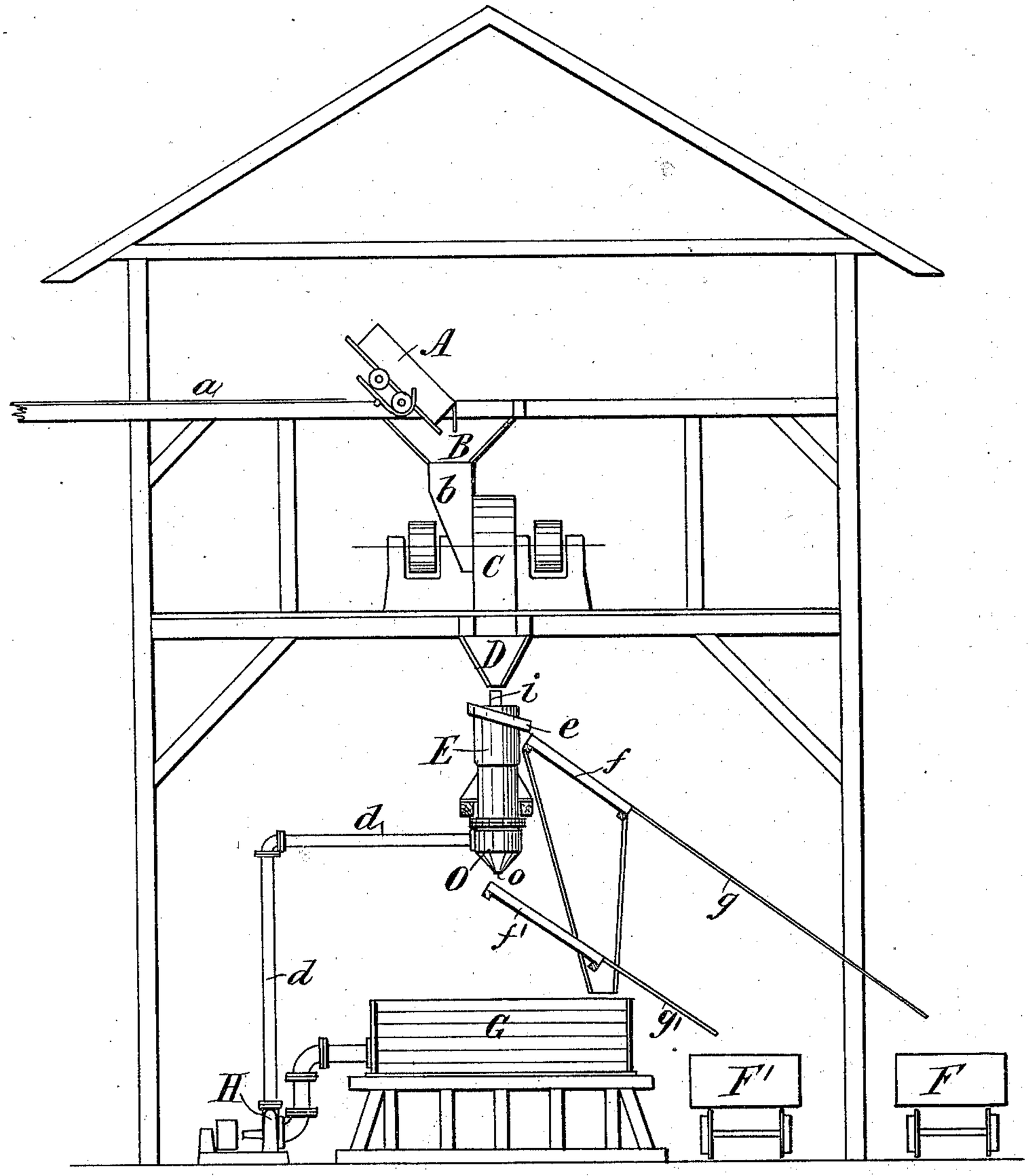
(No Model.) 4 Sheets—Sheet 1.

R. BOERICKE.

COAL OR ORE WASHER.

No. 555,920. Patented Mar. 10, 1896.

Fig. 1.



Witnesses
John P. Nordstrom
E. B. Lukson

Rudolph Boericke Inventor
By his Attorney Henry Schreiter

ANDREW B. GRAHAM, PHOTO-LITHO. WASHINGTON, D.C.

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Fig. 2.

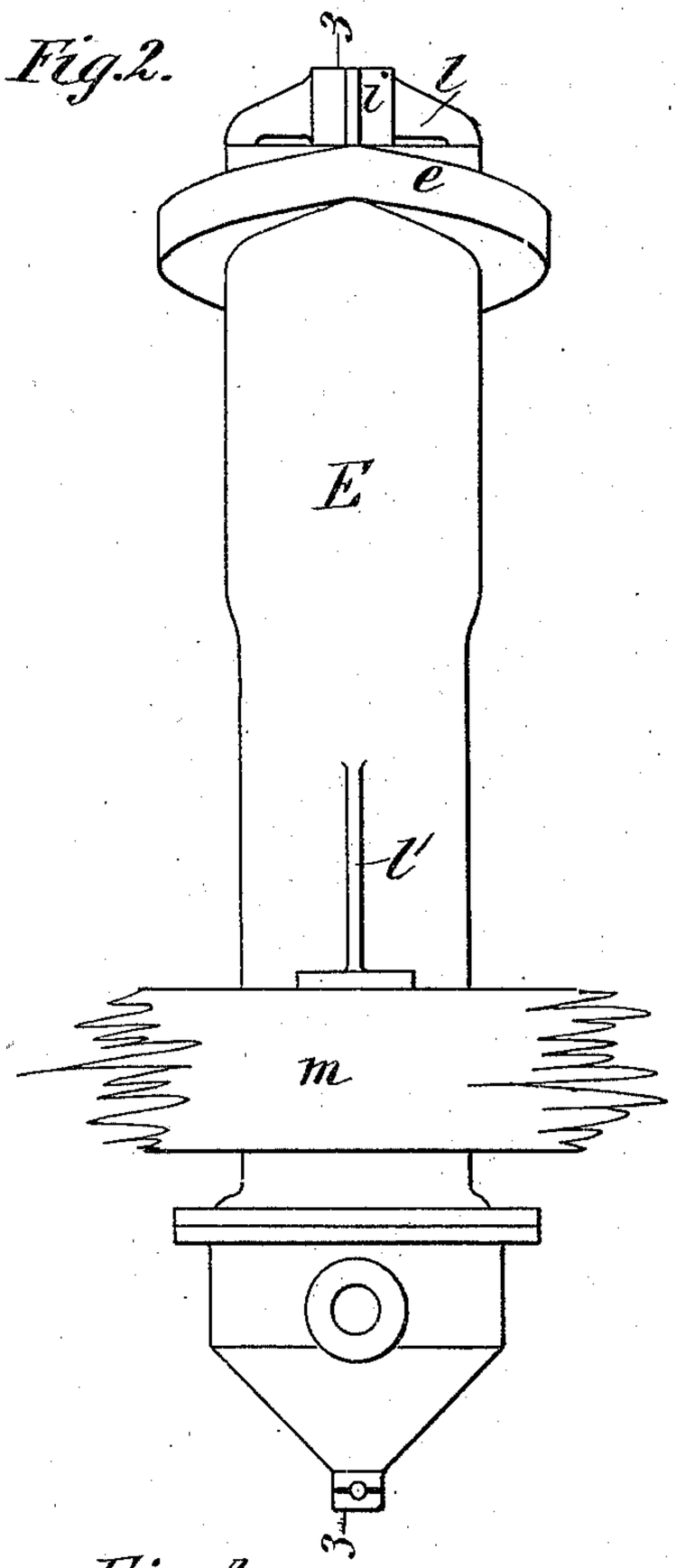


Fig. 3.

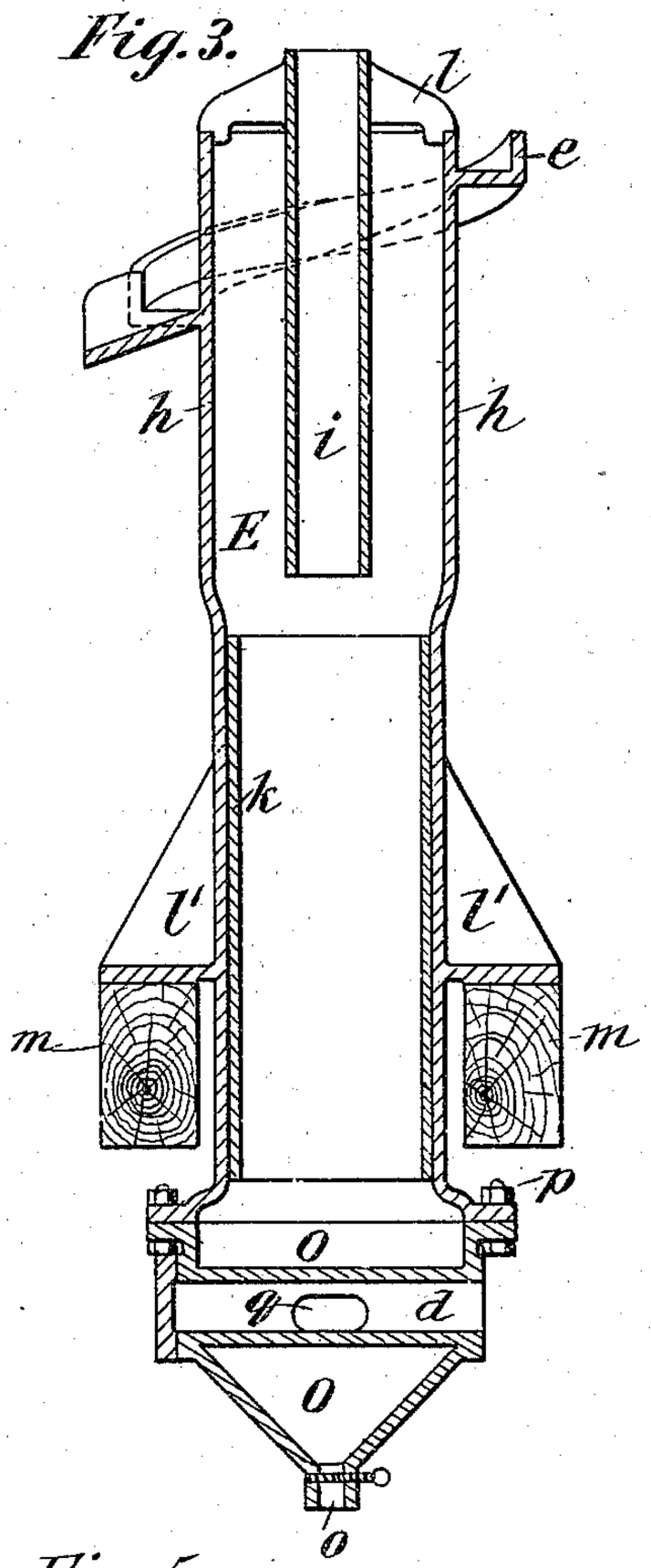


Fig. 4.

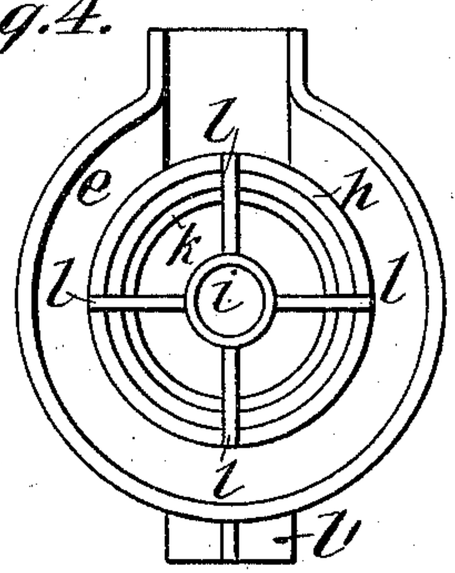
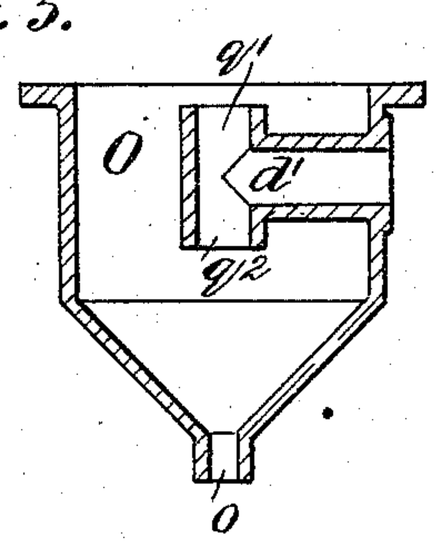


Fig. 5.



Witnesses
John P. Nordstrom
C. C. Kiele

Rudolph Boericke Inventor
By his Attorney Henry Schreiter

ANDREW B. GRAHAM, PHOTO-LITHO. WASHINGTON, D.C.

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R. BOERICKE.

COAL OR ORE WASHER.

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Fig. 6.

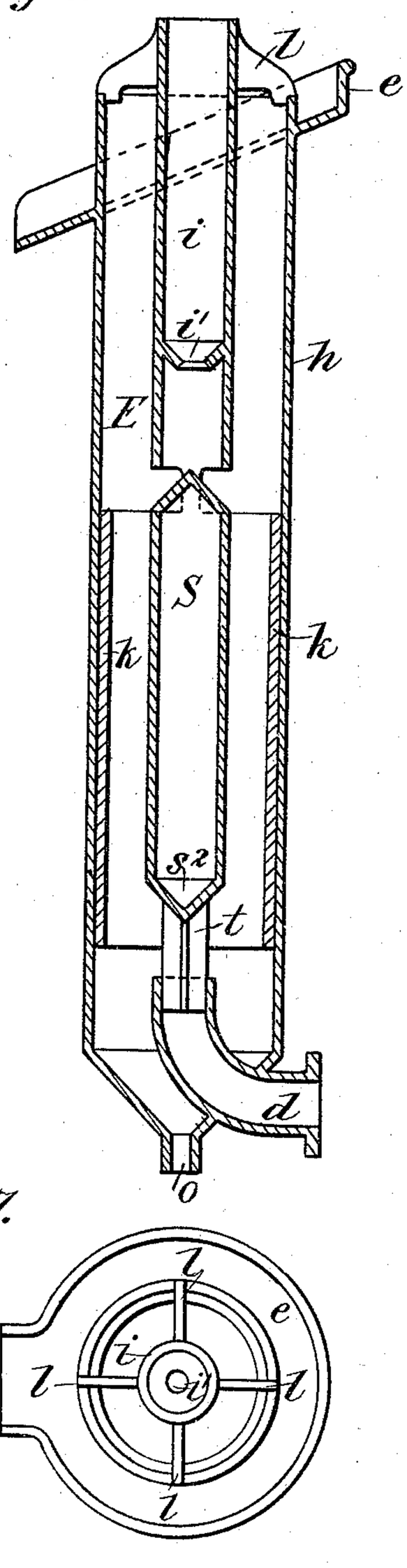

Fig. 7.

Witnesses
John P. Nordstrom
C. C. Wilcox

Rudolph Boericke Inventor
By his Attorney Henry Schreiter

ANDREW B. GRAHAM. PHOTO-LITHO. WASHINGTON, D.C

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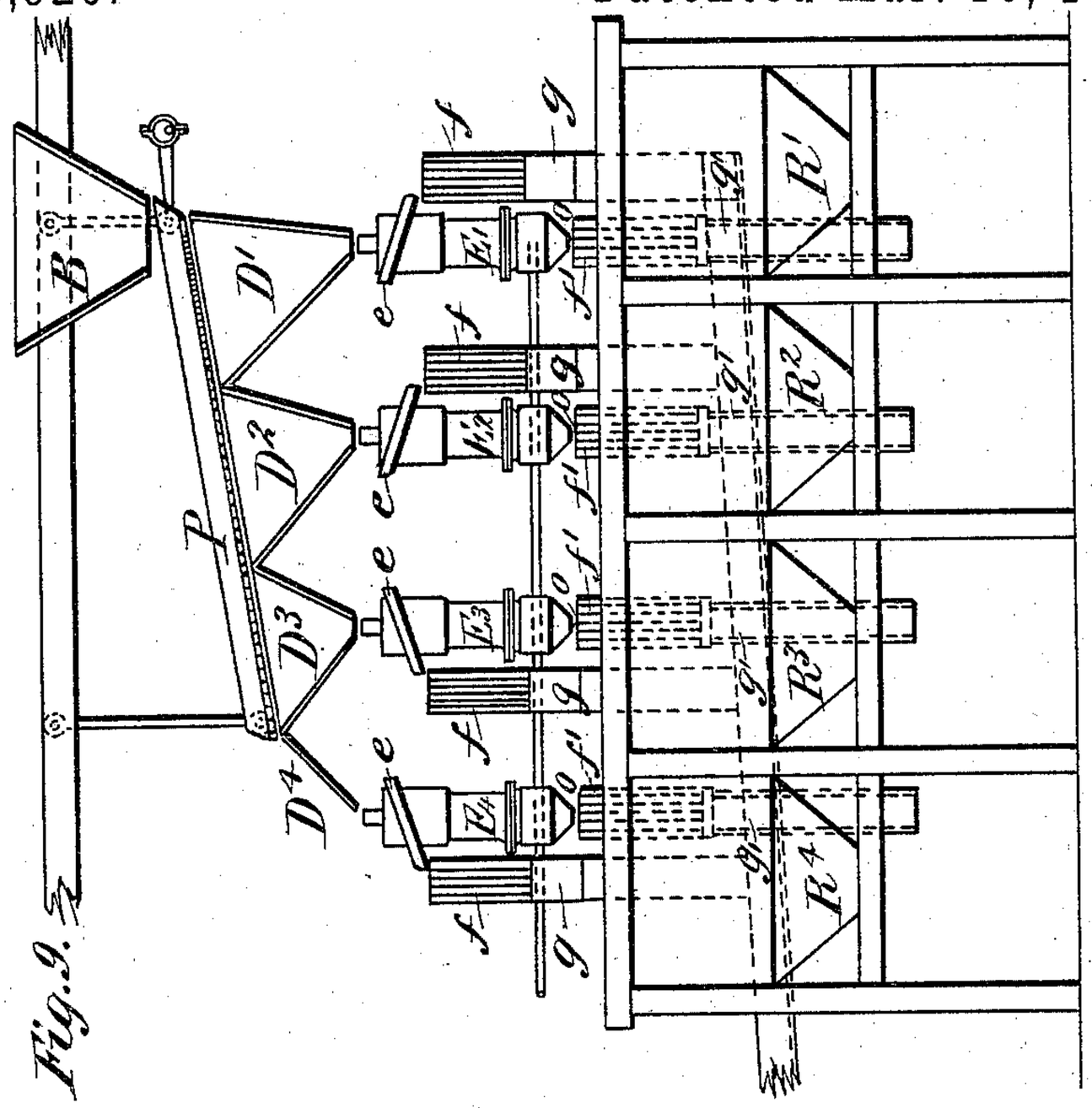

Fig. 9.

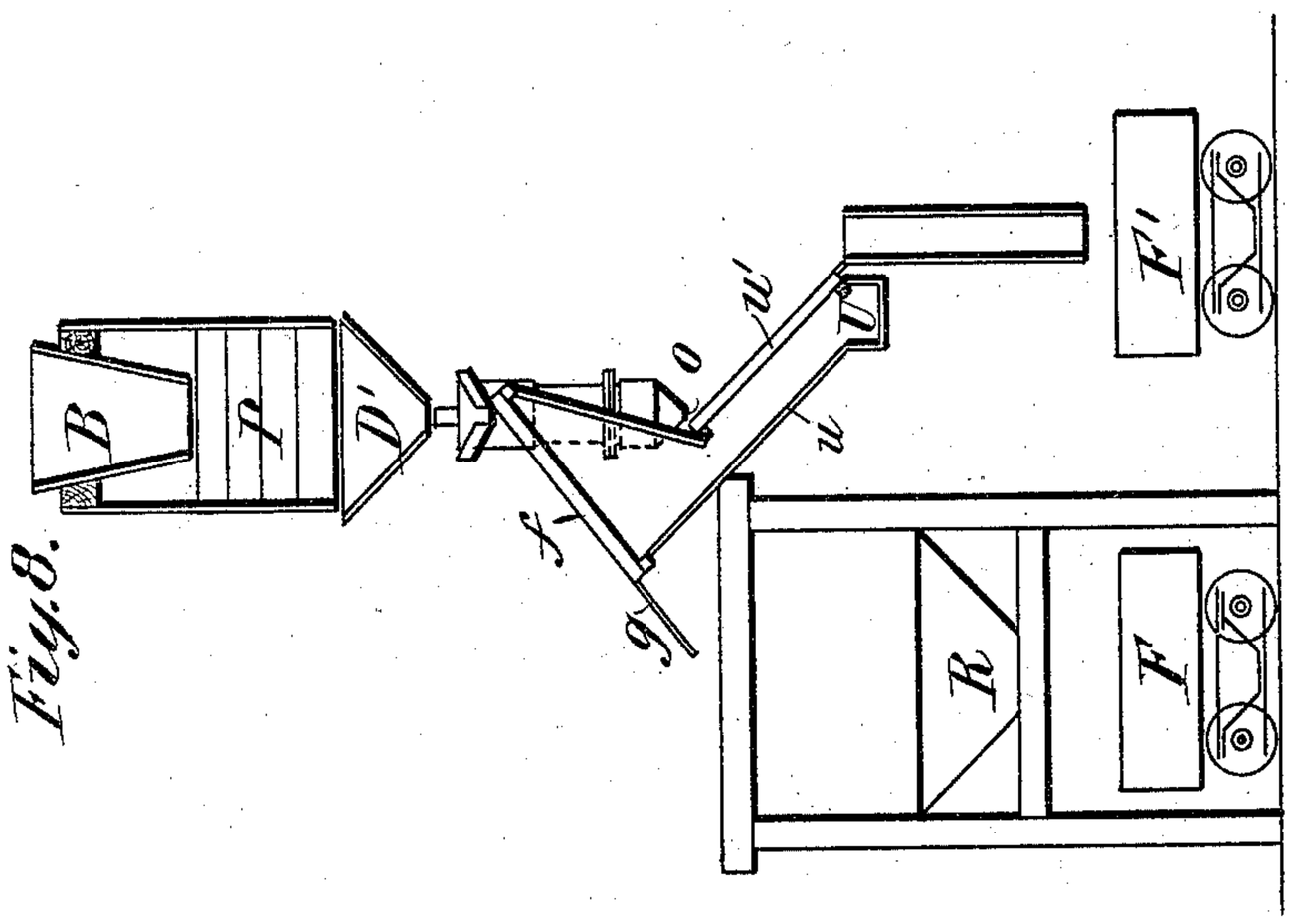

Fig. 8.

Witnesses
John P. Nordstrom
E. C. Nielson.

Rudolph Boericke Inventor
By his Attorney Henry Schreiter

ANDREW B. GRAHAM, PHOTO-LITHO. WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

RUDOLPH BOERICKE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO STEIN & BOERICKE, LIMITED.

COAL OR ORE WASHER.

SPECIFICATION forming part of Letters Patent No. 555,920, dated March 10, 1896.

Application filed September 25, 1895. Serial No. 563,607. (No model.)

To all whom it may concern:

Be it known that I, RUDOLPH BOERICKE, a citizen of the United States, and a resident of Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Coal or Ore Washing Contrivances, of which improvements the following is a full, clear, and exact specification, reference being had to the accompanying drawings, wherein—

Figure 1 is a sectional view showing how my improved washer is used in a coal-washing plant. Fig. 2 is a side elevation; Fig. 3, an axial vertical section on line 3 3, indicated in Fig. 2; and Fig. 4, a top view of the washer. Fig. 5 is a vertical axial section of a modified construction of its lower part. Figs. 6 and 7 are a vertical section and a top view, respectively, of a modified construction of my coal and ore washer. Fig. 8 is an end elevation, and Fig. 9 a front elevation, of a plant for washing of coal of different sizes.

My invention relates to contrivances for separating of coal and of ores from other minerals and tends to provide an efficient apparatus for this purpose to be operated either by water or by compressed air, or by both.

The operation and construction of my improved washer are based on the behavior of differently large particles of one material or of materials of different specific gravities in a column of water agitated by a current moving upward. The current will resist the natural tendency of the material to sink and will, according to its force and velocity, retard or even reverse its downward (sinking) motion. The heavier (specifically) the material the greater force and velocity of the current will be required to retard or reverse its motion. If the velocity of a current sufficiently strong to sustain certain material suspended in the water is greater than that with which the material sinks, its downward motion (sinking) will be reversed and the material carried upward with the current. If two or more materials of different specific gravities are charged into the water and the agitating-current made only strong and swift enough to sustain the lighter material, the heavier material will resist its force and will sink, whereas the lighter material will be carried upward with the current. Thus when crushed raw coal is passed through the washer, the slate, pyrites, and other impurities separated from it, having a greater specific gravity than coal, will sink when the current flowing through the washer is made only strong and swift enough to drive the coal upward. The current must be made to move in the washer upward with a greater velocity than the particles of coal would sink and again smaller than the sinking velocity of the heavier impurities to be separated from the coal. The agitating-current may be a stream of water, of air or of both combined and must necessarily be injected into the washer through or near its bottom. Its force and velocity may be regulated by varying its volume, or the pressure under which it is driven, or, if the volume and pressure are held constant, its velocity may be regulated by increasing or reducing the sectional area of the space in the washer, through which the current moves upward.

With these ends in view I construct my improved coal or ore washer, combined with other necessary apparatus, as shown in Fig. 1 of the drawings, and working as follows:

The coal (or ore) hauled from the mine in cars A on track *a* is delivered in the hopper B and falls through funnel *b* into crusher C, where the lumps are broken and disintegrated. A constant stream of water passing through crusher C flows together with the crushed material into the hopper D and through tube *i* into the washer E. The disintegrated particles of material are met by an upwardly-moving stream of water (or of compressed air) driven into the washer through pipe *d*. This upward current, whose force and velocity are adjusted according to the size and kind of material to be separated, drives the lighter material (coal) upward and finally over the edge of the hull *h* into the gutter *e*, and from there over screen *f* and chute *g* into a suitable receptacle F, preferably a car. The heavier parts—in coal-washing, the slate and stone—will resist the force of the current and sink slowly, accummulating in the funnel-shaped bottom part O of the washer, and this residue is discharged through outlet *o*, over screen *f'* and chute *g'* into the receptacle F. Tank G, arranged underneath washer E, re-

ceives the water overflowed from the washer and also the water escaping with the residue discharged through outlet *o*. Pump H draws the water from tank G and drives it again through pipe *d* into the washer. This plant is designed for use in mines where the supply of water is limited.

The construction and arrangement of the several parts of the washer are shown in section, Fig. 3. The washer consists of hull *h*, which may be cylindrical, prismatical or slightly tapering toward the lower end. I make the hull preferably in the shape shown in Figs. 2 and 3, the lower half being narrowed to reduce the area of its section to the area of the circular space around the tube *i* in the upper part, wherein the current of water driven from underneath moves upward. Tube *i* is suspended centrally in hull *h* on lugs *l*, resting on its upper edge. Gutter *e*, surrounding the hull of the washer near its top, is either cast in one piece with the hull or screwed to it and supported on brackets. Lugs *l'*, also cast in one piece with the hull or screwed to it, support the washer in framing on beams *m* in position. Hull *h* is flanged on its lower end, and the bottom part O is secured to it by bolts *p* passing through the flanges. It is made larger in diameter than the hull of the washer to give the residue space for settling and collecting therein, and its funnel-shaped bottom terminates in outlet *o*, preferably closed by a valve or a damper. The discharge of the residue accumulating herein may be either continuous or intermittent. Pipe *d*, conducting a stream of water or compressed air into the washer, enters into the bottom part O. It passes through diametrically, as shown in Fig. 3, and is provided with two apertures *q* situated on opposite sides in the middle of the washer or terminates into a T-piece *d'* open on both ends and set coaxially with the hull.

The arrangement shown in Fig. 3 will produce an equally strong current through the whole area in the washer and avoids clogging of pipe *d* by the sinking residue when the inflow is shut off.

In the modified construction shown in Fig. 5 in section the stream of water (or compressed air) is driven through both openings q' and q^2 of the T-piece. In this arrangement the inlet-tube *d* is liable to be clogged by the sinking residue, but the cleaning of the apparatus is also facilitated. In such case a sufficiently long iron rod is inserted through tube *i* and driven through the apertures q' and q^2 of the T-piece *d'*, and finally through outlet *o* of the apparatus.

When coal is fed rapidly into the washer, the concentrated force of its motion and mass will produce in the center of the column a contrary current downward, and consequently coal would be carried down to the bottom, if the force and velocity of the current opposing the downward motion of the material fed in the washer is not made equal to the concentrated force of its mass and velocity. In such case I make the upper opening q' of T-piece *d'* larger and opening q^2 correspondingly smaller. This will produce a stronger current, having also a somewhat greater velocity in the center of the washer. This current will disperse the downwardly-moving mass of coal and slate over the whole area of the washer, and all coal will be driven upward.

The velocity of the current in the upper and lower part of the washer must also be regulated according to quality and size of the material to be washed. This I do by setting liner or bushing *k* accordingly, thereby increasing or reducing the area of the passage for the current, or compensating for the reduction, caused by the flow of the washed material. Liner or bushing *k* is made of the same material as the hull of the washer and is screwed to it after having been adjusted in position.

In coal-washing the greater part of the material flows upward through the annular space around tube *i*, and diminishes correspondingly the passage for the current. This reduction of the area causes a material increase in the velocity of the current through this part of the washer. To compensate for this acceleration and to prevent slate from being carried upward with the coal, I set the bushing or liner *k* in the lower part of the washer and diminish also the volume of the current by reducing the inflow in the washer through pipe *d*.

If ore is to be washed containing more than fifty per cent. of heavy particles, the liner or bushing *k* is adjusted in the upper part of the washer, because then a greater quantity of the material will move downward through the lower part of the washer, accelerating the motion of the current therein.

In Figs. 6 and 7 I show a modified construction of my improved coal-washer. This apparatus consists of a cylindrical or prismatical drum E, having also a funnel-shaped bottom with outlet *o*. Tube *i* is similarly suspended on lugs *l*, as in the apparatus described above, and is provided with an interposed funnel *i'* to concentrate the flow of the material to be washed. Diverter S, set coaxially with the hull of the apparatus, may be cylindrical or prismatical in shape and serves a two-fold purpose in this apparatus. Its first purpose is to equalize the area of the lower part of the washer with that of the upper part, and its second purpose is to divert and distribute equally the current moving through the washer and to divert and distribute the charged material in the open space where the current moves upward. A similar liner or bushing *k*, as described above, is employed for regulating the velocity of the current through the washer.

A stream of water or of compressed air is driven into the washer through pipe *d*, entering on one side of the funnel-shaped bottom. In the opening of the inlet-tube *d* is placed

socket t, supporting diverter S. Socket t is constructed of two intersecting planes with an appropriate indenture on its top end to receive the conically-shaped lower end s^2 of the diverter.

The stream of water (or of compressed air) enters the washer through the apertures left open between the wings of the socket t and passes around diverter S, as explained above, into the open space between hull h and tube i and driving with it particles of coal, separated from impurities, over the upper edge of the washer into the gutter e. The upper edge of the washer is horizontal, and as the overflow passes with uniform force and velocity over the whole circumference it is absolutely impossible that particles of material, not approximately equal in size or not of equal specific gravity, could be driven into the gutter e.

In Fig. 8 I have shown an end view, and in Fig. 9 a front elevation, of a plant for washing and assorting of coal of different sizes. The coal is dumped into the hopper B and passes over screen P, having meshes gradually increasing in size toward its lower end. This screen divides the coal according to its size, the smallest grade falling into hopper D', the next larger in size into hopper D^2, &c., and the largest pieces sliding finally on chute D^4 into washer E^4. The coal accumulated in hopper D' falls gradually into washer E', the coal from hopper D^2 into washer E^2, and from hopper D^3 into washer E^3. Washers E', E^2, E^3, and E^4 are adjusted, as described above, according to the quality and size of the coal to be washed therein, the current passing through them moving slowest in E', where the smallest coal is washed, and swiftest in E^4, where its velocity must be sufficient to carry upward large lumps of coal, and where also largest and heaviest lumps of impurities will be gathered.

The washed coal is discharged from the washers into gutters e, passes over screens f and chutes g into storage-bins R, R', R^3, and R^4. The slate and other material, separated from the coal, are discharged through outlets o over screens f' and chutes g' into suitable receptacles F'. The water drained from the washed coal and from the residue, discharged through outlets o, is gathered on branch gutters u and u' into the main gutter U, conducting it into a waste-sewer, or, where it should be necessary to use the water over again, into a clarifying-tank.

In a plant, working to save smudge, the water overflowing with the washed coal from the washers is conducted in separated gutters into a clarifying-tank.

Upon this specification I claim as new and desire to secure by Letters Patent—

In an ore or coal washer, the combination of a separator-hull, a circular inclined gutter or chute upon the exterior hull-wall, an open top in the hull, a concentric inlet-tube for the material projecting into the hull, a bushing in the hull adjustable longitudinally thereof, an outlet in the hull-bottom, a transverse inlet above said outlet, conveyers for the material located above the hull and conveyers for the inclined gutter and the lower outlet of the hull.

In witness that I claim the improvements described in the foregoing specification I have signed my name in the presence of two subscribing witnesses.

RUDOLPH BOERICKE.

Witnesses:
AUGUST STEIN,
HANS WENIGER.