(No Model.) 4 Sheets—Sheet 1.

I. SINGER & M. W. JUDELL.

PROCESS OF CLEANING WOOL.

No. 406,781. Patented July 9, 1889.

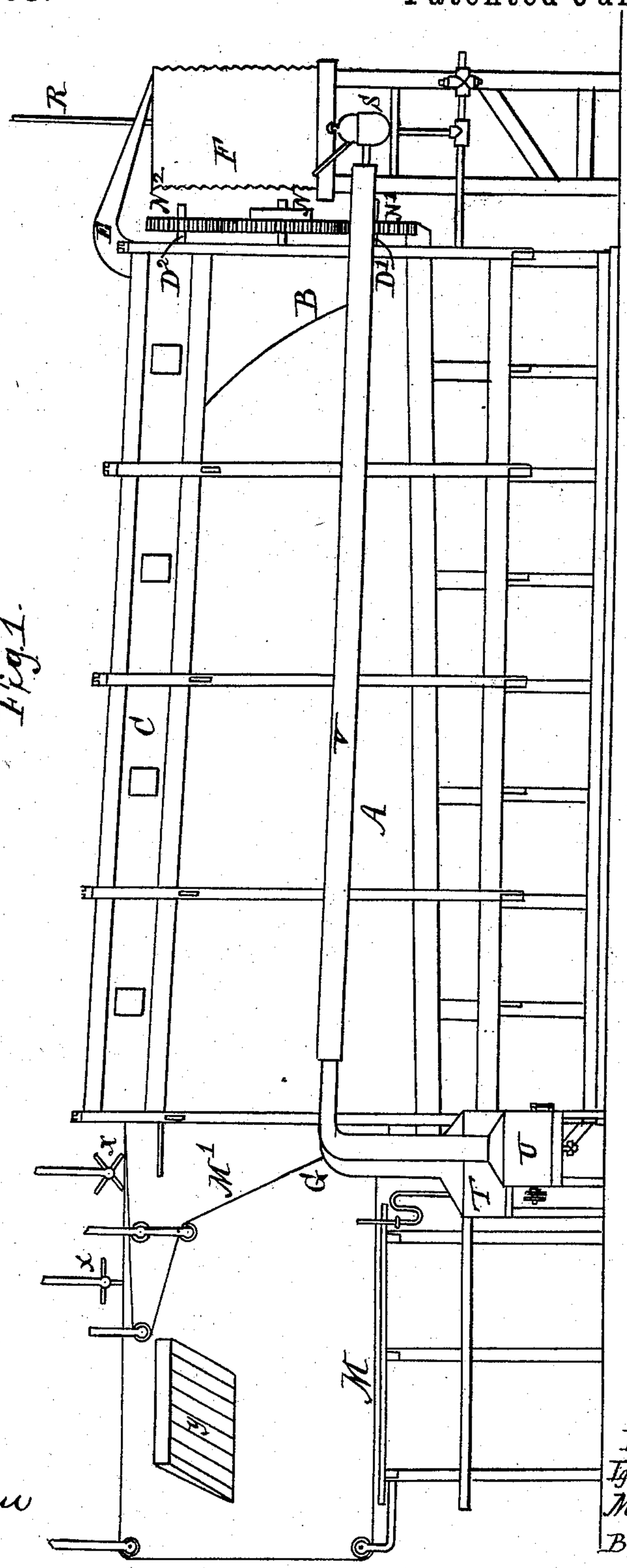

Fig. 1.

Witnesses
W. E. Bowen
E. R. Brown

Inventors.
Ignatius Singer
Moritz Wolff Judell
By Richards & Co
Attorneys

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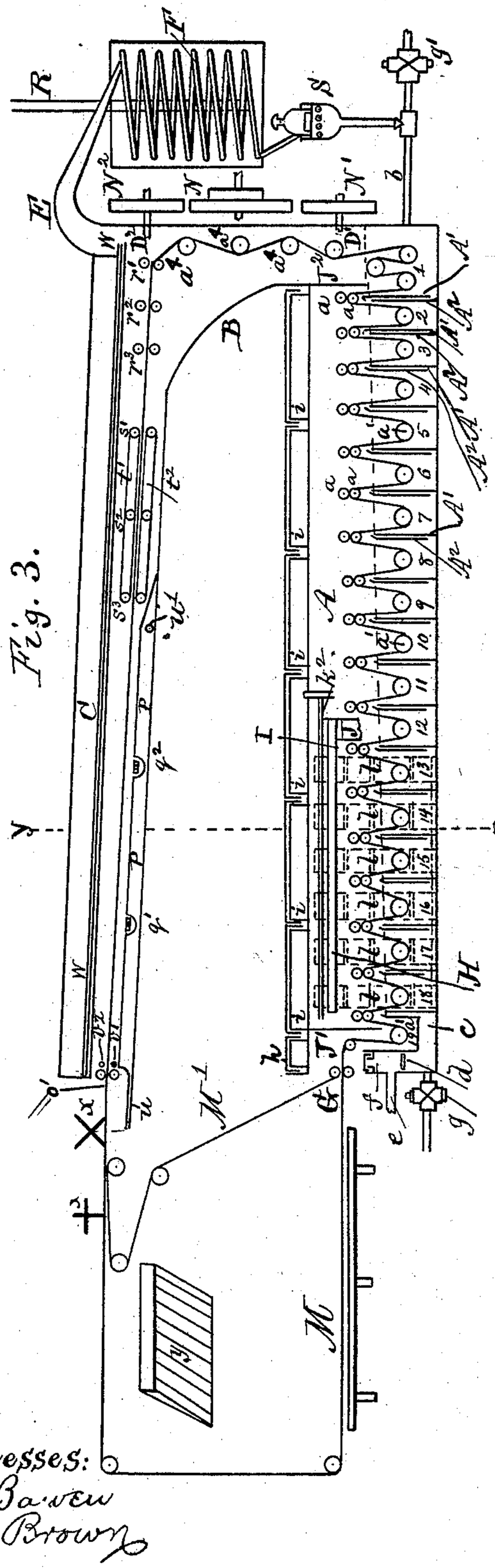

Fig. 3.

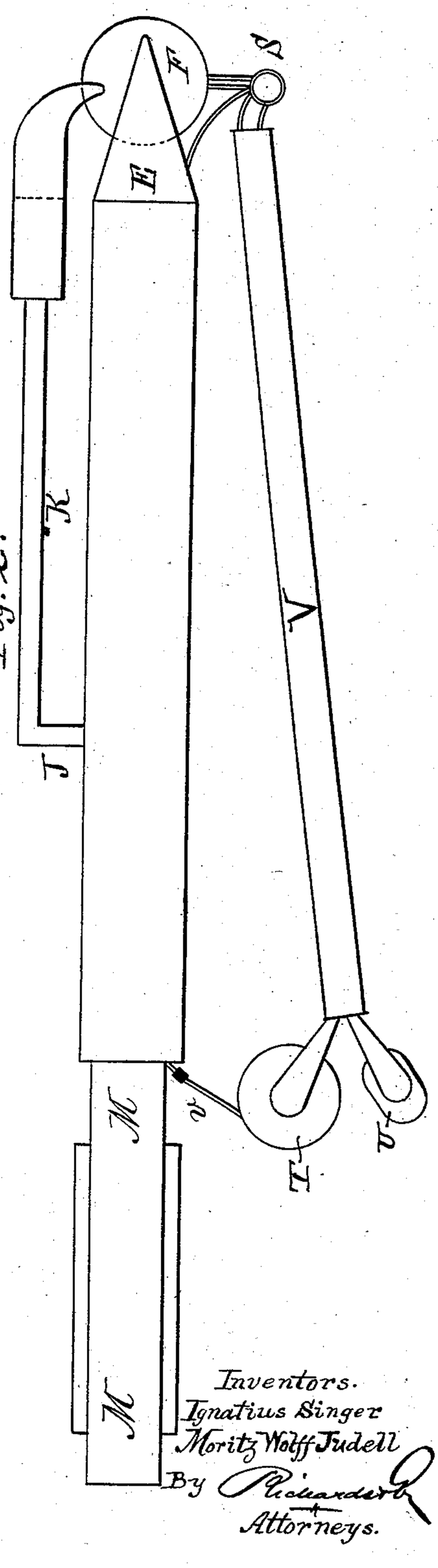

Fig. 2.

Witnesses:
W. E. Bowen
E. R. Brown

Inventors.
Ignatius Singer
Moritz Wolff Judell
By Richards & Co.
Attorneys.

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Fig. 4.

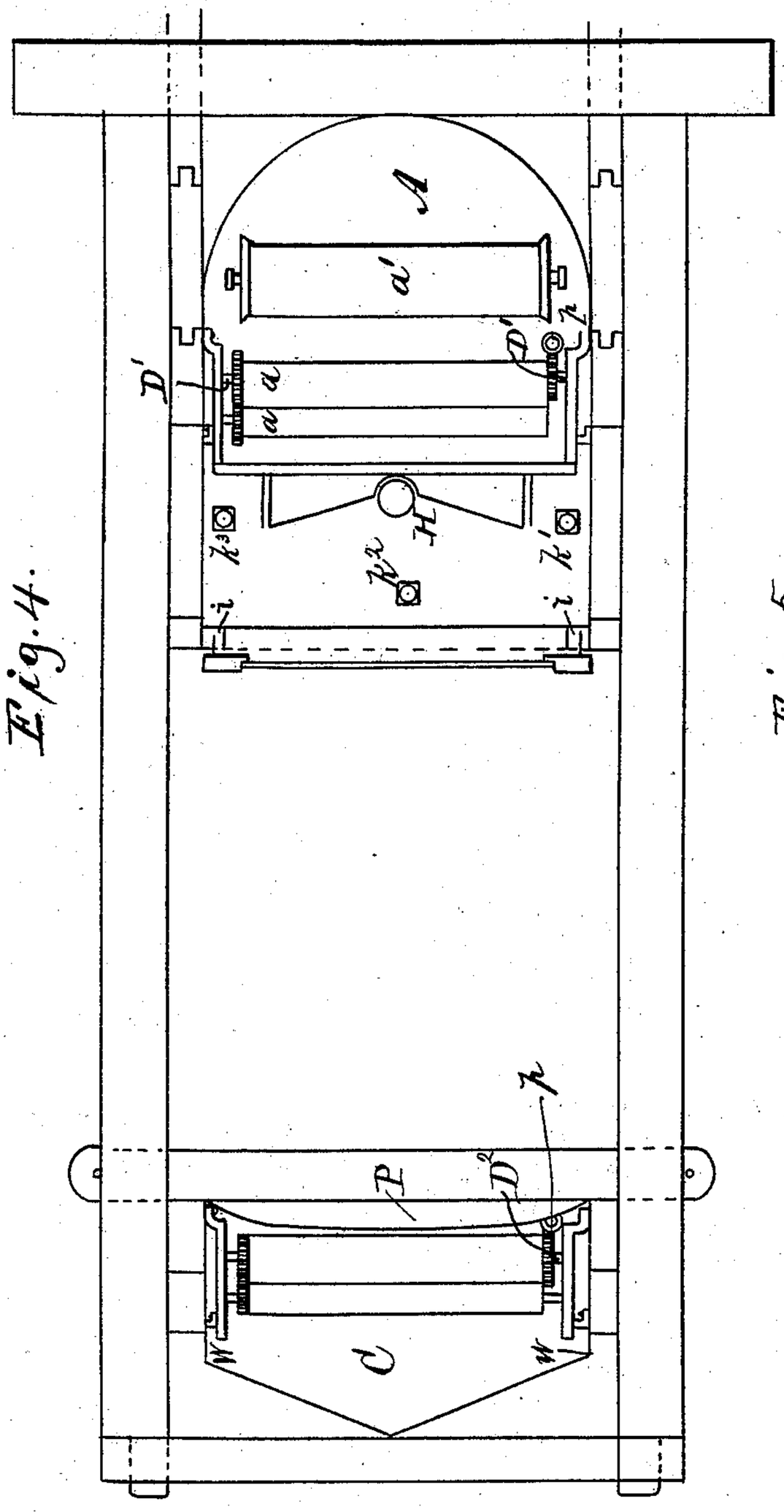
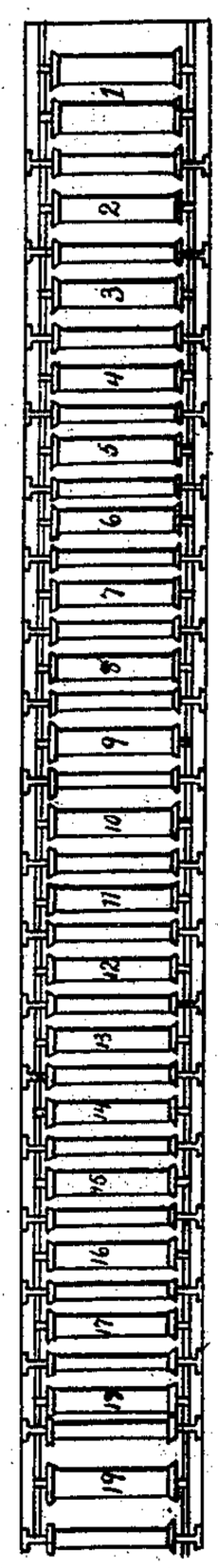


Fig. 5.



Witnesses:
W. E. Bowen
E. R. Brown

Inventors.
Ignatius Singer
Moritz Wolff Judell
By Richards & Co.
Attorneys.

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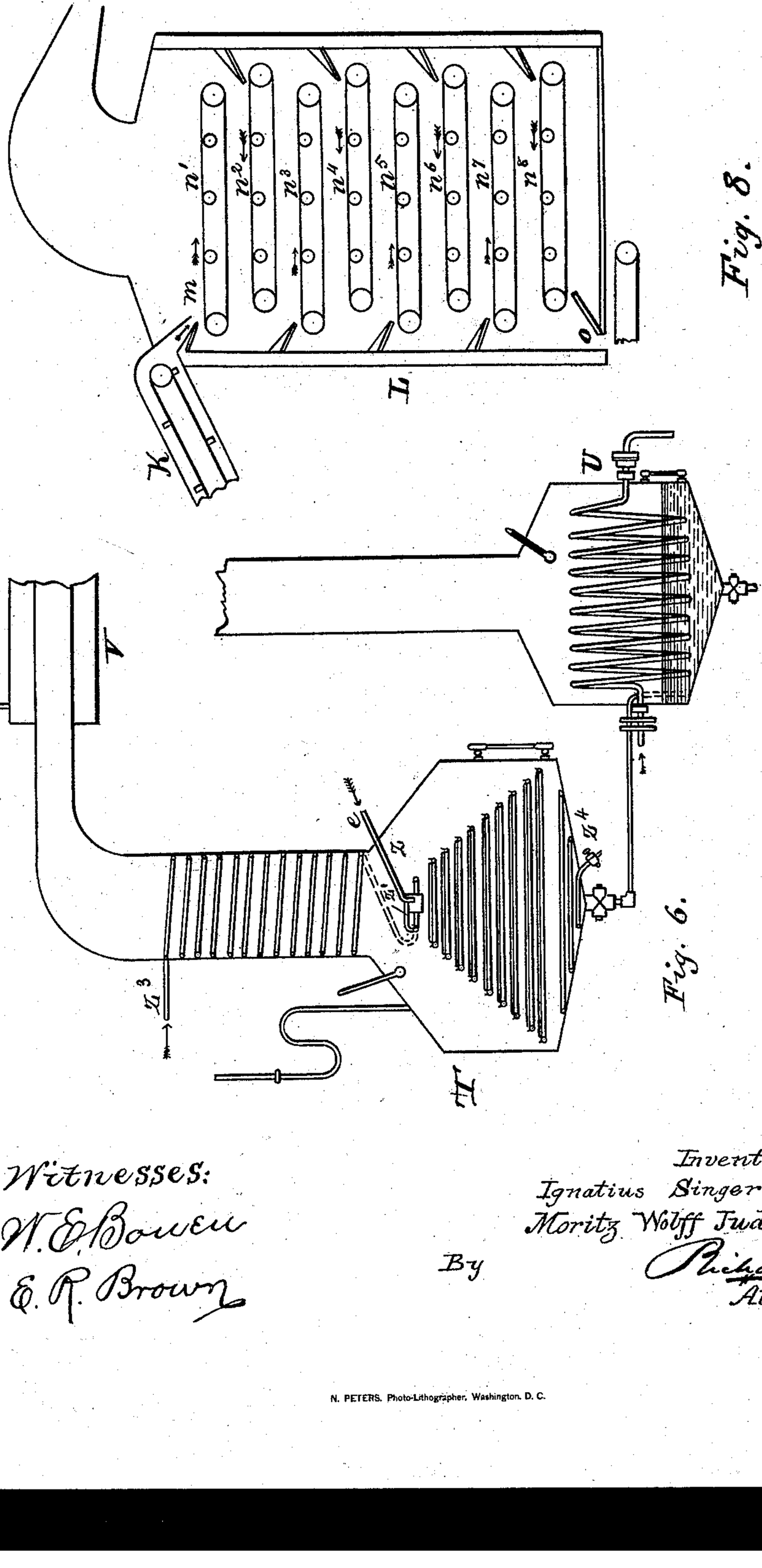

Fig. 8.

Fig. 7.

Fig. 6.

Witnesses:
W. E. Bowen
E. R. Brown

Inventors.
Ignatius Singer
Moritz Wolff Judell
By Richards & Co
Attorneys.

UNITED STATES PATENT OFFICE.

IGNATIUS SINGER AND MORITZ WOLFF JUDELL, OF ADELAIDE, SOUTH AUSTRALIA.

PROCESS OF CLEANING WOOL.

SPECIFICATION forming part of Letters Patent No. 406,781, dated July 9, 1889.

Application filed May 18, 1888. Serial No. 274,287. (No model.) Patented in South Australia January 16, 1888, No. 945; in Victoria January 17, 1888, No. 5,566; in New South Wales January 18, 1888, No. 443; in Queensland January 20, 1888, No. 387; in New Zealand January 30, 1888, No. 2,772; in Tasmania January 31, 1888; in England February 20, 1888, No. 2,532; in Belgium March 3, 1888, No. 80,861; in Luxemburg March 6, 1888, No. 964; in France March 9, 1888, No. 189,234; in Germany March 23, 1888, No. 46,015; in Cape of Good Hope May 25, 1888, No. 6/307; in Spain June 30, 1888, No. 7,998; in Italy July 12, 1888, XLVI, 301, and in Austria-Hungary October 3, 1888, No. 18,530 and No. 31,644.

To all whom it may concern:

Be it known that we, IGNATIUS SINGER, chemist, of Adelaide, in the Province of South Australia, and MORITZ WOLFF JUDELL, importer, also of Adelaide aforesaid, subjects of the Queen of Great Britain, have invented an Improved Process for Cleansing Wool and Like Material, (patented in South Australia January 16, 1888, No. 945; in Victoria January 17, 1888, No. 5,566; in Queensland January 20, 1888, No. 387; in New Zealand January 30, 1888, No. 2,772; in Tasmania January 31, 1888; in Spain June 30, 1888, No. 7,998; in New South Wales January 18, 1888, No. 443; in Great Britain February 20, 1888, No. 2,532; in Belgium March 3, 1888, No. 80,861; in Luxemburg March 6, 1888, No. 964; in France March 9, 1888, No. 189,234; in Cape of Good Hope May 25, 1888, No. 6/307; in Germany March 23, 1888, No. 46,015; in Italy July 12, 1888, Vol. XLVI, No. 301, and in Austria-Hungary October 3, 1888, No. 18,530 and No. 31,634,) of which the following is a specification.

Our invention relates to an improved process for cleansing in a continuous and automatic manner wool and like material from grease and other foreign matters by treatment with bisulphide of carbon. In what follows we include in the term "wool" all similar materials to which our process is applicable.

Our process consists in macerating the wool by passing it automatically and continuously through bisulphide of carbon, removing sand and other earthy matters during the earlier stages of the maceration, and in the latter stages eliminating potash and other salts soluble in water but insoluble in bisulphide of carbon, We pass the bisulphide, after it has become laden with fatty matters from the wool, through a filter and thence into a retort, where it is distilled off, and after being condensed re-enters the macerator. The resultant fat or grease is treated in a rectifier, and on the last traces of bisulphide being driven off is removed for further treatment. The wool is, in its course through the macerator, repeatedly subjected to cold compression, whereby the greater portion of the solvent is removed, and in order to drive off the last traces of the solvent the wool is conducted through a drying-chamber, where it meets a counter-current of dry-heated air. The wool on emerging from the apparatus may be subjected to the action of revolving beaters, in order to remove any loose foreign matter which may still adhere to it.

We carry out our process in such a manner that the wool in a thin layer is kept in constant motion, and while passing through the macerator is met by a counter-current of the solvent. By causing the solvent to enter the macerator at the opposite end to the wool and to flow through it in a continuous stream the wool, as it becomes cleaner, meets purer bisulphide until the last traces of grease are removed. The wool is then made to pass through water, by which the potash and other salts, soluble in water but insoluble in bisulphide of carbon, are removed. By the cold compression of the wool during the process of maceration the greater portion of the solvent is expressed without subjecting the wool to a continuously high temperature. A great saving of fuel and time is effected in the final recovery of the solvent by distillation, which is by this means accomplished with scarcely any loss. After being placed on the feeding-table the wool does not require to be touched by hand until the operation of cleansing is completed. The flow of the solvent is automatic, and when the cells are once filled to the required height the outflow and inflow are practically equal. As a further advantage, the grease is recovered in a filtered condition, whereby its after treatment is greatly facilitated.

For the purpose of carrying our process into effect, we employ apparatus which partly forms the subject of another application filed January 19, 1889, Serial No. 296,277, but which we now describe in order that our process may be more clearly understood.

The macerator is a large trough divided

into a number of cells by double partitions which gradually increase in height from the end where the wool enters until the highest is attained at the end where the solvent enters the macerator. At the lowest end, where the wool enters, the solvent leaves the macerator saturated with grease or fat. The wool is placed between a double endless band or apron composed of suitable wire gauze or netting, which passes between pairs of rolls placed over each partition of the cells and around a single lower roller in each cell. After passing through a number of cells containing bisulphide of carbon, the double band with the wool passes through two or more cells containing water, in which are dissolved the potash and other salts insoluble in bisulphide of carbon, and thence up a vertical passage into a drying-chamber, where, after passing through a series of cold and heated rollers, in order that as much as possible of the solvent may be expressed, it moves over a heated surface and between heated rollers met by a counter-blast of heated air, by which the last traces of the solvent are driven off, so that the wool leaves the drying-chamber perfectly free from grease or moisture. The band may then pass under revolving beaters, which shake out the dry particles of foreign matter still adhering to the fiber, after which the wool is deposited on a delivery-chute. The bisulphide of carbon saturated with grease as it leaves the macerator passes through a suitable filter and flows thence into a retort, where it is quickly evaporated, and after passing through a condenser it re-enters the macerator, thus continuously circulating. The vapors from the drying-chamber are driven by the heated blast, before mentioned, into a suitable worm, and pass through the same condenser into further use. The grease obtained in the first retort flows into a second retort or rectifier. Here the last traces of the solvent are removed, and the grease in a purified condition is then ready for further treatment. The water for the dissolving of the potash or other salts is drawn off, when necessary, and replaced by taps provided for the purpose. The first six cells (more or less) at the end where the wool enters, and where consequently the greater quantity of earthy matters are deposited, are provided with revolving dredgers, which remove the solid particles and deposit them as sludge in a channel placed above the upper rolls. This channel is provided with a screw-carrier and endless band, by means of which the sludge is carried to a kiln, where the adhering solvent is recovered. The rolls through which the double band containing the wool passes and from which it receives its motion are provided with cog-wheels and gearing driven in the usual way by shafts connected on the outside of the apparatus. The whole of the gearing except the outside driving-wheels is contained inside the apparatus, which is made air and vapor proof by means of lids provided with water seals.

In order that the apparatus for carrying out our invention may be the better understood, we now proceed to describe the same by reference to the accompanying drawings, in which similar letters refer to similar parts.

Figure 1 is a side elevation of the apparatus; Fig. 2, a plan of the same; Fig. 3, a sectional elevation of the macerator and drying-chamber with frame-work removed; Fig. 4, a vertical section of the same through a line Y Z; Fig. 5, a plan of the macerator, showing the rollers; Figs. 6 and 7, sectional elevations of the concentrating and rectifying retorts; Fig. 8, sectional elevation of the sand-drying chamber.

The metal trough A is constructed with an outer frame-work or covering of wood or iron, the roof of which is composed of lids consisting of iron frames having glass panes, and is made vapor-proof by hydraulic seals *i*, Figs. 3 and 4. The trough A is divided by double partitions A′ A^2 into a convenient number of cells, numbered, respectively, 1, 2, and so on, Fig. 3. The partitions are provided with valves close to the bottom of the cells, leading from one into the other, through which the contents can be drained off when desired. The partitions A′ of the cells No. 1 and 2 are constructed of such depth as not to quite reach the bottom of the trough, the other partition A^2 reaching to the bottom, but being lower at the top than A′. In cells Nos. 3 and 4 and the others afterward this order is reversed, A′ in each case being lower than A^2 and reaching to the bottom, while A^2 terminates at a short distance from the bottom.

B is a vertical channel leading from the macerator to the drying-chamber C above.

D′ D^2 are shafts in A and C, by which the rollers are driven.

E is a hood connecting the vertical chamber B with a condensing-worm F.

G is the entrance of macerator A for the double band or apron carrying the wool.

H is a gutter for sludge obtained from cells near the wool entrance of A.

I is an Archimedean-screw carrier in A.

J is a chute leading from the gutter H to an endless band K, connecting with the kiln L.

M M′ are endless wire aprons for carrying wool.

N is the main driving-pinion connecting wheels of equal size N′ N^2, attached to the shafts D′ D^2.

P is the plate of steam-chest in C.

R is a flue leading from worm F, and S is the receiver of the worm.

T is the concentrator for solvent charged with grease.

U is the rectifier for the grease.

V is a channel connecting T and U with the receiver S.

a a are pairs of rolls connected by cog-wheels and placed over each partition in the macerator A.

a' is a roller or idler in the body of each cell.

b is a pipe for entrance of the solvent.

c is the settling-tank under the filter *d*, above which is an overflow-pipe *e*, leading to the concentrator T.

f is the lid of settling-tank *c*, provided with a water seal.

g is a stop-cock for draining *c*.

g' is the stop-cock of supply-reservoir.

h is a water seal over wool-entrance cell.

i i are water seals of roof of A.

J' J² are partitions extending down into the cells at both ends of A.

k' k² k³ are shafts of dredger-propellers.

l are buckets of dredger.

m is the entrance of the sand-drying chamber L.

n' to *n⁸*, Fig. 8, are endless bands of the chamber.

o is the exit for dried matters.

p, Fig. 4, are worm-wheels of the main driving-shafts D' D².

q' q² are eccentric rollers in the drying-chamber C.

r' r² r³ are cold rollers in the vertical passage B.

s' to *s³* are heated rollers in the drying-chamber.

t' t² are endless felt bands carried by rollers *s'* to *s³*.

u is a steam-inlet into chest P.

v' v² are pipes of hot air blast of drying-chamber.

w are gutters of roof of same.

x are revolving beaters for removing dry foreign matters.

y is a wool-chute to baling-floor.

z', Fig. 6, is the cup of concentrator T.

In carrying out our process by means of this apparatus we fill the cells 1 and 2 with water and all the others with bisulphide of carbon. The bisulphide of carbon, which enters at *b* or falls through the vertical chamber B, being specifically heavier than water collects at the bottom of cell No. 1, and, rising between the partitions A' A², overflows into cell No. 2, and thence into No. 3. In each of the other cells the lower partition A² allows the grease (which being specifically lighter than bisulphide of carbon rises to the surface) to flow with the solvent from one to the other until it reaches the settling-chamber *c*, by which time the solvent has become saturated. In order to entirely prevent entrance of water into cell 3, cell 2 may first be charged with bisulphide as high as the bottom of partition A', or a slight quantity of water may be permitted to be forced over into cell 3 at the commencement of the operation. On leaving the settling-chamber *c* any solid particles of earthy matter are retained below by the filter *d*, the purified solution being conducted from above the filter by the pipe *e* to the retort or concentrator T. From the pipe *e*, Fig. 6, the solvent passes into the cup *z'* and overflows through a spout into a half-round channel which runs along the back of a spiral steam-coil. A large heating-surface is thus obtained and the greater portion of the solvent driven off in vapor through the condensing-channel V into the receiver S. The grease is run off from time to time into the second retort or rectifier U, Fig. 7, where the last traces of the solvent are removed by a revolving steam-coil, the liquid grease being then drawn off. We remove the sediment accumulated in *c* through the stop-cock *g* from time to time, or by opening the lid *f* and taking out the filter *d*. The cell nearest to the wool-entrance at G is disconnected from the rest and is kept empty during work, but at other times is filled with water. A partition J', secured to the frame-work of the water seal *i* and soldered to both sides of the cell, by dipping into the water forms a hydraulic seal which prevents the escape of any vapors from the macerator. A similar seal is formed by the partition J², which dips into the water of the cell No. 1 nearest the entrance of the bisulphide. To the partition J² is fixed a small exhaust-pump actuated by an eccentric fixed to the shaft D'. The pump, by sucking air from the macerator A and discharging it into the channel B, removes any bisulphide vapors which may be generated, and thus prevents their escape at G. The second and several following cells from the wool-entrance G (we do not confine ourselves to any definite number) are provided with dredgers, each consisting of two endless link-chains which pass lengthwise down the cell clear of the frame of the idlers *a'* and at right angles to them. The dredger-chains are driven in the usual manner by three shafts *k' k² k³*, Fig. 4, actuated by the shaft D'. To the chains are attached a number of small dredger-buckets *l*, which bring up the sludge from the bottom of the cells and empty it into the gutter H, the bottom of which is perforated in order that the bisulphide may drip back into the cells. An endless screw-carrier I takes the sludge to the chute J, through which it falls onto an endless band and is carried to the chamber L, Fig. 8, where the bisulphide is driven off.

The chamber is a modification of Lecambre and Persac's drying-chamber, and consists of a chamber containing a series of endless bands *n'* to *n⁸*, Fig. 8, which revolve at a uniform speed and on which the sludge after being introduced at *m* is carried, meeting in its passage a blast of heated air until it reaches the outlet at *o* in a perfectly dry condition. The vapors of bisulphide driven off in the process pass through a channel into the condenser and flow thence into the macerator. The axles of the upper rolls *a*, Fig. 4, rest in a slide, as in ordinary wringers or mangles, and are pressed down by spiral springs placed in the upper part of the hollow frame-work. The

lower rolls are fitted with a worm-wheel *p*, Fig. 4, by means of which they are driven in the usual way from the shafts D′ D². The upper and lower rolls are connected with cog-wheels of equal size in the usual way. The main driving-shafts D′ D² are provided with gear-wheels of equal size, both actuated by the main driving-wheel N, and thereby a uniform speed of the rolls *a*, and consequently of the band M, is secured throughout the apparatus. The endless bands or aprons M M′ are constructed, preferably, of thin copper or brass wire net, with one-quarter to one-half inch mesh, and are driven at a uniform rate through the apparatus. The wool is fed to M in a thin layer or open fleeces, and on entering the macerator at G is covered by the second band M′. Passing through the first set of rolls, the wool is dipped by the idler *a′* into the solvent, and on leaving the cell is squeezed by the rolls *a a* before entering the next cell. So it passes from cell to cell, meeting in its course a constant counter-current of the solvent until the water-cells 2 and 1 are reached. Here the salts, insoluble in bisulphide of carbon, are removed by the action of water, renewed as may be required by means of suitable taps. The wool then passes in zigzag fashion over the idlers *a*⁴ in the vertical chamber B, and after being well squeezed in the cold rolls *r′* to *r*³ enters the drying-chamber C. It is here met by the drying-rolls *s′* to *s*³. The rolls *s′* to *s*³ are hollow and are heated by steam. They are also provided with endless bands of felt, or thick flannel, between which the wool passes and by which the moisture is absorbed. As the band M travels on, the wool is next taken in an undulating manner by the eccentric rolls *q q*² over the drying-plate P, being met in its passage by a heated blast from the pipes *v′ v*², and leaves the drying-chamber at *o′* perfectly dry. Any dry earthy particles still adhering to the fiber may be removed by the revolving beaters *x*, under which the wool is passed before reaching the delivery-hood chute *y*, where the bands M′ M² separate and allow it to fall from them. The plate P is heated by means of steam introduced from the pipe *u*, the condensed water being drawn off at *u′*. The dry heated blast from the pipes *v′ v*² carries the bisulphide vapors toward the delivery-hood E. The inclined roof of the drying-chamber C is provided with internal gutters on either side, which catch any condensed vapors and carry them to the channel B. The vapors from the retorts T U, the chamber L, and the worm F are carried to the common receiver S, provided with a glass bell-cover, whence the condensed liquid flows back to the macerator through the inlet *b*. It will be seen that the whole of the solvent leaving the macerator flows back in a continuous and uniform stream into the first cell to circulate again and again through the macerator. The flow of bisulphide into the retort is thus self-regulating, governed by the flow from the receiver S into the macerator, insuring a constant supply of saturated solution to the retort.

We wish it to be understood that we do not claim as new the use of bisulphide of carbon as a solvent.

Having now particularly described and explained the nature of our said invention and the best manner we know of performing the same, we claim—

1. The process of cleansing wool and like material, consisting in passing the same continuously through a constantly-flowing counter-current of bisulphide of carbon for the purpose of removing grease and other impurities, and subsequently passing the wool through a chamber in which it is subjected to the action of heated air, substantially as set forth.

2. The process of cleaning wool and like material, consisting in passing the same continuously through a constantly-flowing counter-current of bisulphide of carbon for the purpose of removing grease and other impurities, and then expressing the solvent without heat, and afterward passing the wool through a heated chamber provided with heated rollers and a counter-blast of heated air for the purpose of removing the remaining traces of the solvent, substantially as set forth.

3. The process of cleaning wool and like material, consisting in passing the same continuously through a vessel containing bisulphide of carbon for the purpose of removing grease and other impurities, then removing the solvent by the action of heated air, then condensing the volatilized bisulphide of carbon, and then returning the said product of condensation to the said vessel, substantially as set forth.

4. The herein-described process of cleaning wool and like material, consisting in passing the same into and out of the successive cells of a trough or vessel adapted to contain a liquid, and simultaneously passing a liquid current of bisulphide of carbon from one cell to the next in a direction opposite to the movement of the wool, whereby the material is alternately immersed in and withdrawn from a liquid of progressively-increasing purity, substantially as set forth.

In witness whereof we have hereunto signed our names in the presence of two subscribing witnesses.

IGNATIUS SINGER.
MORITZ WOLFF JUDELL.

Witnesses:
FRANCIS HUGH SNOW,
JOHN EDWIN JEFFREYS.