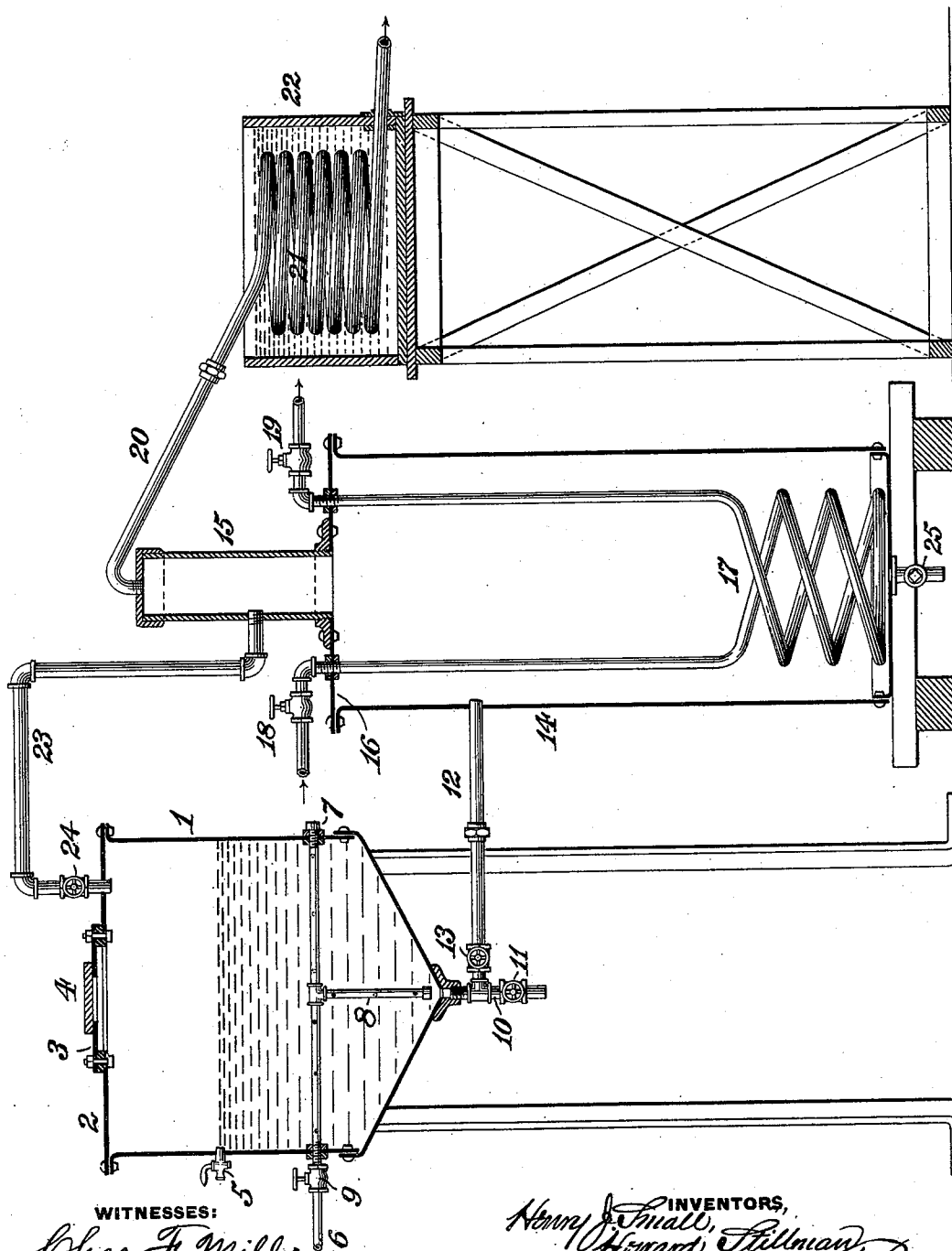


(No Model.)

H. J. SMALL & H. STILLMAN.
APPARATUS FOR MANUFACTURING BENZENE.

No. 595,788.

Patented Dec. 21, 1897.



WITNESSES:

Chas. F. Miller.
S. R. Bell.

INVENTORS,
Henry J. Small,
Howard Stillman,
By J. Mendenhall.
Att'y.

UNITED STATES PATENT OFFICE.

HENRY J. SMALL AND HOWARD STILLMAN, OF SACRAMENTO, CALIFORNIA.

APPARATUS FOR MANUFACTURING BENZENE.

SPECIFICATION forming part of Letters Patent No. 595,788, dated December 21, 1897.

Application filed January 6, 1897. Serial No. 618,159. (No model.)

To all whom it may concern:

Be it known that we, HENRY J. SMALL and HOWARD STILLMAN, of Sacramento, in the county of Sacramento and State of California, have invented a certain new and useful Improvement in Apparatus for the Manufacture of Benzene, of which improvement the following is a specification.

The object of our invention is to effect the utilization of the liquid benzol which is obtained as a by-product in the operation of the "Pintsch-gas" plant by the manufacture therefrom of benzene in a simple and inexpensive manner.

To this end our invention, generally stated, consists in a novel apparatus for treating Pintsch benzol with sulfuric acid, agitating the mixture by the action of compressed air, settling and drawing off the acid, adding concentrated lye and agitating with compressed air, settling and drawing off the lye sludge, and finally distilling in a steam-still, the essential feature of said apparatus being the combination of an agitator, a compressed-air-supply pipe, a steam-still, a condenser, and valved connections for effecting the performance of the several above-recited operations.

The improvement claimed is hereinafter fully set forth.

The accompanying drawing is a vertical central section through an apparatus adapted to the practice of our invention.

In the manufacture of Pintsch gas a hydrocarbon-benzol compound passes, with the fixed gas, from the retorts to the gasometer and in the process of compressing the gas for use is condensed and runs off as a light liquid having a dirty yellow color and foul odor, which consists of hydrocarbons of the benzol series, (C_6H_6), together with homologous compounds and others unidentified, as well as more or less black oil-tar and sulfonic compounds. This liquid is a waste product of the destructive distillation of petroleum-oil and chemically resembles the naphtha found in coal-tar, but contains impurities, as above recited, in much larger amount. It does not, however, contain any of the phenol series known as "creosote" or "tar acid," the same being characteristic of coal-gas processes. In a Pintsch-gas plant used in railroad service

from ten to twenty gallons of this waste product are ordinarily evolved per day, which we refine and clarify to a water-white benzene by a method and in an apparatus the essential features and structural details of which are as follows:

We provide an agitator 1, which is a cylindrical vessel of light—say one-quarter inch—sheet metal having a conical bottom and is made with tight joints to prevent escape of vapor, but is not required to be of strength to resist internal pressure. A head 2, having a central opening of sufficient diameter to admit of the cleansing of the agitator when required, is secured upon its top, and the opening in the head 2 is closed by a tight cap 3, which is removable when required to expose the full opening in the head, and has a smaller central filling-opening which is covered by a loose lid 4, of iron plate, the under side of which is faced with leather and which remains sufficiently tight by its own weight.

A petcock 5 is fixed to one side of the agitator at such a height above its bottom as to indicate a determined volume of charge—as, say, fifty gallons—and a compressed-air-supply pipe 6, leading from a compressor, reservoir, or other source of air under pressure, extends across the lower portion of the agitator. The end of the air-supply pipe 6 is closed by a plug 7, and it is provided with a branch pipe 8, extending from a T at its center nearly to the bottom of the agitator and closed at its lower end. The air-supply pipe is controlled by a valve 9 and has a series of small perforations throughout its length within the agitator. The branch pipe 8 is similarly perforated.

A pipe 10 is connected to the agitator at its lowest point and is controlled by a drain-valve 11 near its lower end, and a pipe 12, controlled by a valve 13, leads from the pipe 10 above the valve 11 to a steam-still 14, which is preferably a cylindrical vessel having a central stand-pipe 15 connected to its lid or head 16. The agitator and still are also connected by a pipe 23, controlled by a valve 24 and leading from the head 2 of the agitator to the stand-pipe 15. A steam-coil 17, controlled by inlet and outlet valves 18 19, leads from a steam-boiler into and through the still 14, and a delivery-pipe 20 leads from the

stand-pipe to a worm or condenser coil 21, placed in a water-tank 22. The delivery end of the coil 21 may either be led to a benzene-storage tank or be controlled by a suitable
 5 cock or valve adjacent to the water-tank. The still should be provided with a drain cock or valve 25. All pipes and connections are ordinary gas pipe and fittings.

In the practice of the process a determined
 10 quantity (indicated by the petcock 5)—as, say, fifty gallons—of Pintsch-gas benzol is placed in the agitator 1. The valves 11 and 13 are closed and the valve 24 is opened. The valve 9 of the air-supply pipe is then
 15 opened, so as effect the agitation of the liquid, the lid 4 is removed, and commercial sulfuric acid (about five pounds for a fifty-gallon charge of benzol) is gradually poured in. The cover 4 is then replaced and escape of
 20 vapor into the still is permitted through the pipe 23. The agitation of the liquid is continued for about twenty minutes, at the end of which time the air-supply valve is closed. The liquid is allowed to stand for from four to six
 25 hours, in which time the acid will have settled to the bottom, and at the end of which time it is drawn off by opening the valve 11. It will be black or dark green and very foul. The lower portion of the stratum of liquid
 30 above the acid will also be blackened, and the line of separation may not be well defined, in which case about one gallon of the liquid, which will include all the acid, should be drawn off and thrown away. A solution
 35 of caustic soda or concentrated lye (one pound in one gallon of water for a fifty-gallon charge of benzol) is then poured into the agitator through the opening covered by the lid 4, the liquid being agitated during the pouring and
 40 for a short time thereafter by opening the air-supply valve 9. The liquid is allowed to stand for from four to six hours, when the lye sludge is drawn off through the pipe 10 by opening the valve 11 and is thrown away.
 45 The contents of the agitator are then drained into the still through the pipe 12 by opening the valve 13, the valve 11 being closed, and when the agitator has been emptied the valves 13 and 24 are closed. The steam-valves 18 19
 50 are then opened, and as the liquid becomes heated the benzene passes off as vapor through the pipe 20 and will be condensed in the coil 21, running off at the outer end thereof to a suitable receptacle.

55 Care should be taken not to drive off the benzene too rapidly, as in such case it will carry with it some coloring-matter. It should be run off in a stream no thicker than a pencil, and be water-white and clear. The steam
 60 heat may be increased until about forty gallons of benzene are obtained from a fifty-gal-

lon charge of waste benzol. If any liquid thereafter remains in the still, it should be drawn off at the drain-cock 25 and thrown
 65 away. The benzene may be further deodorized, if desired, but at the conclusion of the process described will be in condition for ordinary use for industrial purposes.

The benzene product of the process above described is chemically similar to the solvent
 70 naphtha or benzene as obtained from coal-tar. It has a specific gravity of about 40° Baumé, and should not be confounded with the benzol of commerce, the latter being a direct petroleum product.

75 We have found our benzene product valuable for use in burning in a gas-blast machine using compressed air. Several forms of this machine are used, and the gas or vaporized benzene is available for paint-burning in
 80 copper-shops or in boiler-shops where a large burner is used for softening boiler-plate in flanging, &c. The benzene is rich in hydrogen and burns with an intense blue flame in the blast. Owing to its intense heat in combus-
 85 tion it is more valuable than gasoline burned in a similar manner. It is nearly as volatile as gasoline and may be used instead of it in the ordinary hand-blast lamps employed by
 90 plumbers and painters. It is also a good and rapid solvent of oils, asphalt, tar, &c., and is well adapted for thinning paints where a cheap thinner is desired.

We claim as our invention and desire to secure by Letters Patent—

95 1. In an apparatus for the manufacture of benzene, the combination, substantially as set forth, of an agitator, a compressed-air-supply pipe, a steam-still, a condenser, and
 100 valved connections from the agitator to the still, from the agitator to a point of discharge, and from a source of compressed air to the agitator.

2. In an apparatus for the manufacture of benzene, the combination, substantially as
 105 set forth, of an agitator, a perforated and valve-controlled air-supply pipe discharging thereinto, a still provided with an internal steam-heating coil, a valve-controlled pipe connecting the upper portions of the agitator
 110 and still, a pipe controlled by a drain-valve and leading from the bottom of the agitator to a point of discharge, a valve-controlled pipe leading from the bottom of the agitator
 115 to the still, and a condensing-coil connected to the top of the still.

HENRY J. SMALL.
 HOWARD STILLMAN.

Witnesses:

CHAS. T. HUGHES,
 WILLIAM W. RHOADS.