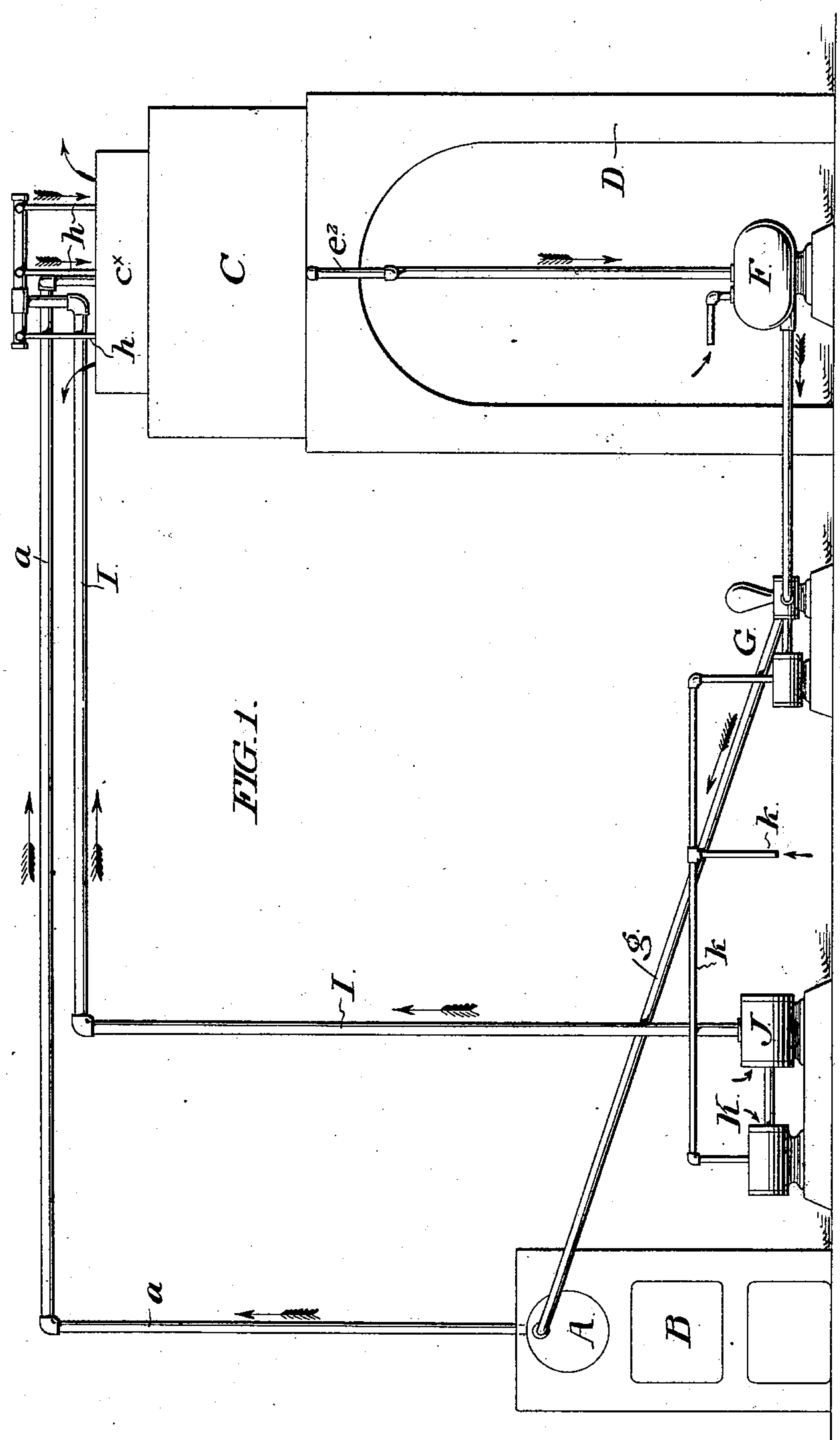
(No Model.) 3 Sheets—Sheet 1.

R. D. UPHAM.

PROCESS OF REFINING ASPHALT.

No. 512,494. Patented Jan. 9, 1894.



WITNESSES:

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R. D. Upham INVENTOR

By his Attorneys

Strawbridge & Taylor

(No Model.) 3 Sheets—Sheet 2.

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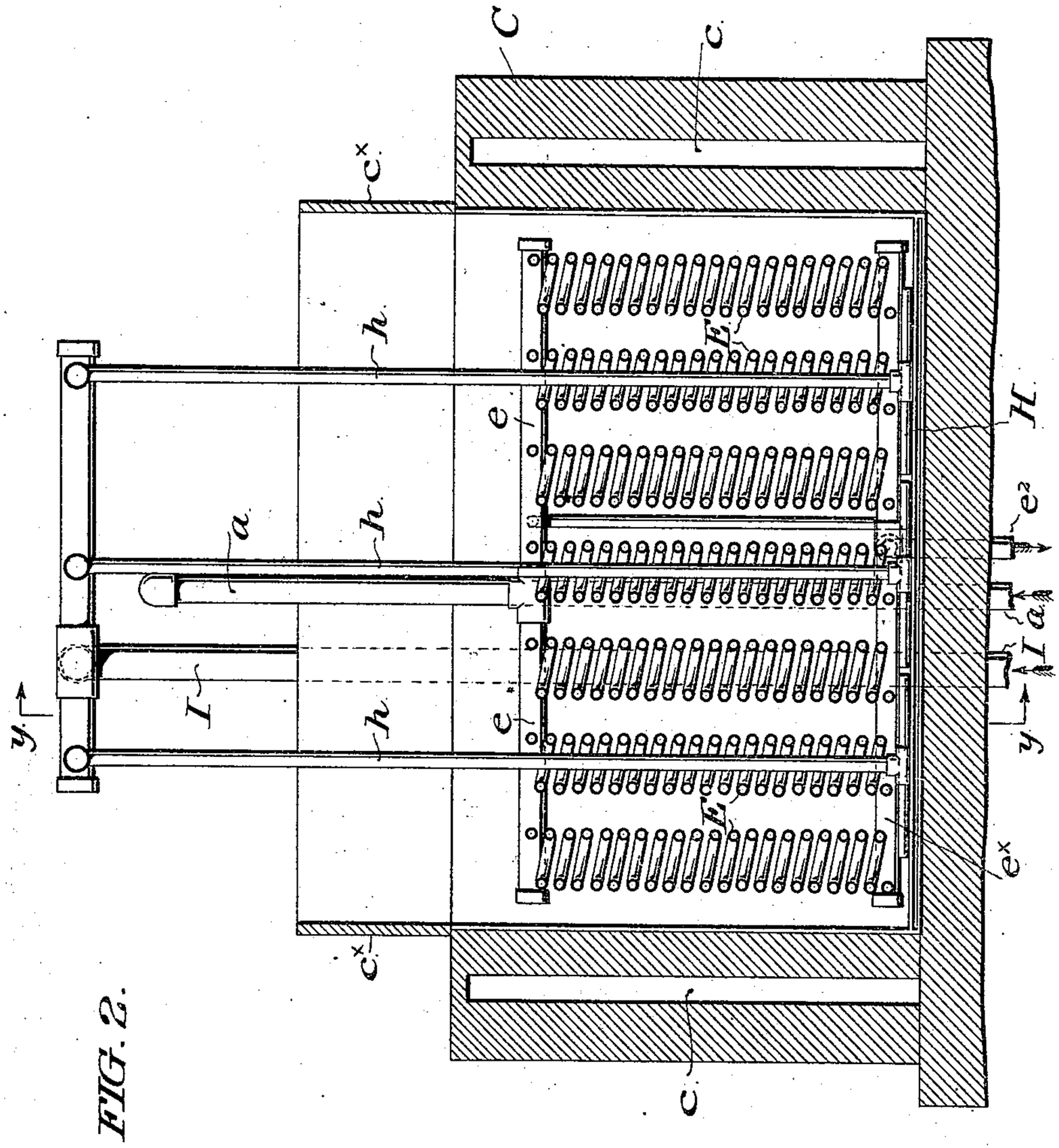

FIG. 2.

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(No Model.)

3 Sheets—Sheet 3.

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FIG. 4.

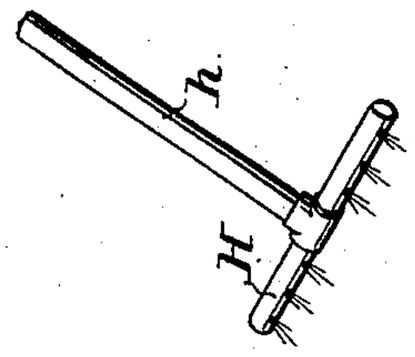
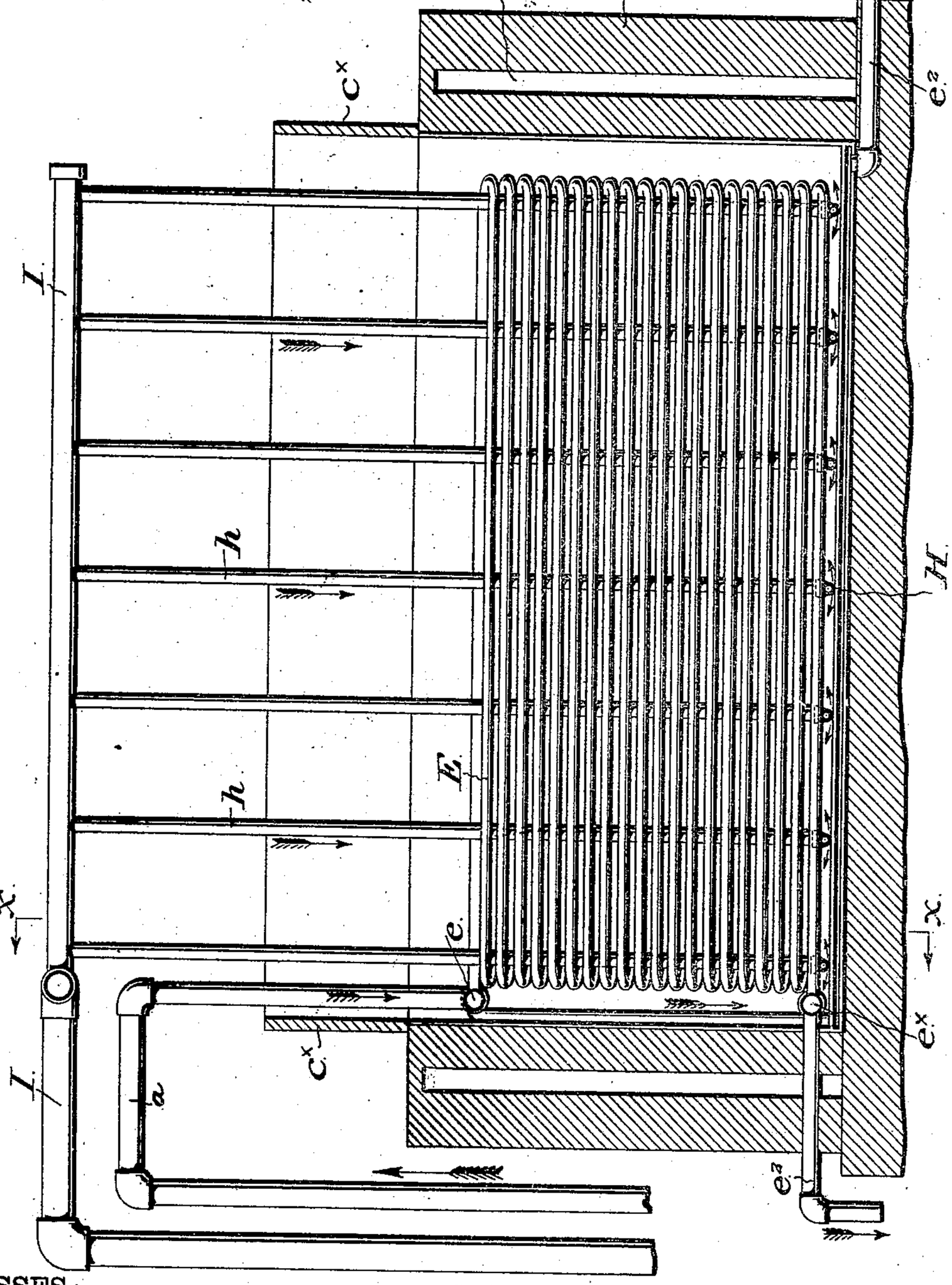


FIG. 3.



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THE NATIONAL LITHOGRAPHING COMPANY.
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

RICHARD D. UPHAM, OF BALTIMORE, MARYLAND, ASSIGNOR TO WALTER S. WILKINSON, OF SAME PLACE.

PROCESS OF REFINING ASPHALT.

SPECIFICATION forming part of Letters Patent No. 512,494, dated January 9, 1894.

Application filed June 16, 1893. Serial No. 477,804. (No specimens.)

To all whom it may concern:

Be it known that I, RICHARD D. UPHAM, a citizen of the United States, residing in the city of Baltimore and State of Maryland, have invented a new and useful Process of Refining Asphalt, of which the following is a specification.

My invention is applicable to all natural asphalts, but particularly to the asphalt obtained from the so-called Pitch Lake of the Island of Trinidad.

In order that my invention may be both understood and distinguished from operations heretofore practiced with other hydro-carbons, it is necessary to explain the composition of natural asphalt, the nature and character of the operations heretofore resorted to for refining it, and the conditions which exist to be complied with by the operation to which I resort.

Asphalt in its crude state is a combination composed essentially of hydro-carbon or bitumen, earthy matter, water, and a small percentage of organic matter. These materials as existent in nature are so intimately mixed mechanically, and the water and hydrocarbon so thoroughly combined, that the crude Trinidad lake asphalt has been denominated an emulsion. Lake pitch contains, in addition to a small percentage of organic and non-bituminous matter, from twenty to twenty-eight per cent. of water, about thirty-eight to forty-two per cent of hydrocarbon or bitumen, and about twenty-six to twenty-eight per cent. of inorganic or earthy matter. The average composition of lake (Trinidad) asphalt, according to the analysis of Professor Clifford Richardson, is as follows:

Water	27.85
Inorganic	26.38
Organic, not bitumen	7.63
Bitumen	38.14
	100.00

The mineral matter is chiefly silica, alumina, oxide of iron, and lime; and the water is thermal water which contains a large percentage of salts of sodium, &c.

Refining, as applied to asphalt, is the process of eliminating, or driving off from it all of its water, and a small percentage of its lighter oils, which are detrimental to its employment as a paving cement. To effect refining by processes heretofore known, the mass must be heated to, and maintained at, a temperature ranging from 340° to 380° Fahrenheit, until the emulsion has been broken down and all the water evaporated. A higher temperature than 380° is injurious to the asphalt, as it drives off oils which are essential to its toughness and plasticity, and it is more and more seriously impaired as the temperature to which it is subjected is increased, and the period during which it is exposed is prolonged. Upon the other hand, asphalt subjected for a long time to heat of much less temperature than 380°, is also injured in the same way by the driving off of some of its valuable oils. These injurious conditions have, however, been inseparable from the methods heretofore employed, with the exception of a certain method invented by Walter S. Wilkinson of Baltimore, Maryland, which forms the subject matter of an application for patent, filed by him in the United States Patent Office June 6, 1893, as Serial No. 476,726, and in which he makes claim to the process of refining natural asphalt, which consists in subjecting it in an open tank or vessel, in its crude state and under agitation, to the action of steam heat disseminated throughout it. Under prior existing processes, with the exception of that of the said Wilkinson, asphalt has been refined in a large vat or kettle, adapted to contain from twenty-five to thirty tons of the crude material, and suspended or supported above a fire, the heat from which passes along its bottom and through a central longitudinally-extending axial flue to a stack. To lessen the danger of injuring the asphalt by overheating, the bottom of this vat or kettle has usually been placed about seven feet above the fire. To maintain the asphalt agitated during the heating operation, revolving paddles have been mounted within the tank, and jets of compressed air have also been employed. Under this practice it has been possible to refine about twenty-five tons of crude asphalt in about sixty hours.

The processes referred to, again excepting that of Wilkinson, have been defective in that

they have been wasteful of heat, the hot gases of combustion escaping in great measure up the stack, without imparting their heat to the stubborn mass of asphalt, and they have also proved injurious to the product,—the bottom of the kettle having become very hot by direct radiation from the fire, and the flue having been exposed to the heat from the gases of combustion,—the asphalt coming in contact both with the over-heated bottom, and with the surface of the flue, having either been too much dried out, a large percentage of the oils being driven off, or having even been burned. These processes, moreover, are wasteful of asphalt, because a considerable percentage of the asphalt settles, adheres to, and is coked upon the bottom of the kettle, becoming not only a total loss, but also entailing expense in its removal. This coke, in fact, represents a quantity of asphalt destroyed, much greater than its own weight or bulk. They are, finally, destructive of the plant, because the fire heat is applied continuously to the iron of the kettle, which has no water in contact with it to carry off the heat and thereby save the metal. These various defects in the processes last referred to and prior to Wilkinson's have been partially remedied by increasing the number and lengths of the flues, and passing the gases of combustion several times through the mass of asphalt, and also by protecting the bottom of the vat from direct fire by means of fire brick. Although, by these means, greater economy in fuel has been secured, yet the time required for the refining has been greatly increased, so that tanks containing from fifty to one hundred tons of crude asphalt, have required constant care for from five to six days, with the result even then that a portion of the asphalt has been destroyed and other portions more or less injured by direct contact with the overheated surfaces. Careless firing has also produced serious loss and damage, and the long time required for the operation has been a serious objection. It is true that quite recently the adoption of air agitation in connection with the most approved fire kettles has reduced the period required to refine a given quantity of asphalt, and increased the quantity of refined asphalt obtained therefrom.

The problem of successfully preparing from crude asphalt material for use as a basis for paving cement and for other purposes, may be stated as follows: Given a mass of material, which is a very poor conductor of heat, and which is therefore a difficult substance through which to diffuse heat,—which can be stirred or agitated only with great difficulty,—which contains a large percentage of water, which must be eliminated, and, when the mass has become liquid, about twenty-six per cent. of inorganic matter in suspension which it is desirable to retain evenly distributed throughout the mass;—*Quœre*:—In what manner, with what least amount of fuel, and in what shortest possible time,—may this water be driven off while the inorganic matter is retained in suspension, and no injury done to the desiccated mass by excessive heat.

I have discovered that, in order to satisfy the foregoing conditions to an extent even greater than that to which they are satisfied by Wilkinson's process, steam, as an agitating agent, discharged directly into the mass of crude asphalt near the bottom of the vessel containing it,—and without regard to whether the mass be subjected to the heat of fire directly or indirectly applied to the vessel, or to the action of steam in circulation in accordance with Wilkinson's process,—produces the most satisfactory results, both as to economy of fuel and time, and as to quality and quantity of product,—it being an interesting fact that any amount of steam or water may, without injury to the asphalt, be discharged into it while being thus treated, the water of the emulsion once vaporized passing off, and any additional water being either vaporized and passing off with the vapor of the thermal water, or else remaining on top of the mass, which will be perfectly desiccated after the original water has been driven off. In fact the asphalt cannot by any means within my knowledge be compelled to absorb any water. It is, moreover, true that agitation of the mass by means of steam, whether the mass be under process of refining by application of flame to the kettle or of steam in circulation throughout it, effects a material saving both in fuel and in time required to refine a given charge, and this for the reason that the heat of the jets of steam aids in the operation of refining,—air, upon the contrary, as an agitating agent, absorbing and carrying off heat from the mass instead of imparting heat to it, while paddles or other mechanical devices involve the cost, delays, and other incidental disadvantages inseparable from machinery. There is, also, when steam injection is resorted to, an appreciable gain in the quality of the refined product, repeated tests having demonstrated that valuable oils are retained, which in the practice of all other known processes are driven off in proportion to the degree of heat applied and to the time during which the mass is subjected to it. Finally, the agitation of steam is more thorough and complete than that of air or paddles, there resulting an augmented product, measurably due to the fact that the material does not settle in any part of the vessel but can be wholly drawn off in a condition of practically uniform consistency. My operation, therefore, to an even greater extent than that of Wilkinson, brings the asphalt into contact with the heated surfaces, thereby breaking down the emulsion, setting free and producing a rapid evaporation of the water from the asphalt, and at the same time keeping the mass so mixed as to prevent

the inorganic matter from settling, and carrying down with it valuable asphalt. In a word, as against the old processes which involve other modes of agitation and the application of direct heat to the vessels, my process, as stated, effects a material saving in the time required to refine a given charge of asphalt,—while as against even the Wilkinson process, it effects an even more material saving in time, and, when employed in connection therewith, enables the operator to employ his circulating steam heat at a much lower pressure and temperature and with the better results enumerated.

In the accompanying drawings I have illustrated a type of apparatus adapted to conveniently carry into practice my process in connection with that of Wilkinson.

In the drawings, Figure 1 is a view in side elevation of the entire apparatus; Fig. 2 a transverse, vertical, sectional, side elevation, through the tank or kettle represented in Fig. 1, section being supposed in the plane of the dotted line *x*—*x* of Fig. 3. Fig. 3 is a longitudinal view otherwise similar to Fig. 2, of the said tank, section being supposed in the plane of the dotted line *y*—*y* of Fig. 2; and Fig. 4 is a fragmentary or perspective detail of one of the perforated steam injection pipes and its feeder.

Referring to the drawings,—A represents a boiler of any preferred character employed for the generation of, preferably, high pressure steam, and B a furnace operative in connection with said boiler.

C is an iron tank or kettle within which the crude asphalt is subjected to the action of the steam from the boiler. This tank may be of any preferred construction, but is conveniently of that represented in Figs. 2 and 3, in which it is assumed to be incased in brick, the walls being formed with an inclosed air space *c*, and the upper opening of the tank (for it is necessarily an open tank) being conveniently surmounted and inclosed by a splash board $c^{\times}$. The tank as an entirety is supported in any preferred manner, conveniently upon framework or upon brickwork such as D, Fig. 1.

E are gangs of steam pipes of any preferred character and arrangement, placed within the tank, and disposed therein at such preferred distances apart as to admit of the introduction between and among them of the crude asphalt, and of the circulation throughout them of the steam employed under the Wilkinson process to effect the direct refining, so to speak. These pipes are preferably continuously supplied with high pressure steam from the boiler A, conveniently through a steam conduit *a*, which leads from said boiler and is conveniently in connection with the said various gangs of transverse feed pipes *e*, or other preferred connection. All of the gangs connect, preferably through transverse discharge pipes $e^{\times}$, with an outlet pipe e^{2} for the water of condensation, which conveniently leads to a chamber F from which the condensed water may by means of a pump G, be returned to the boiler through the return pipe *g*. Other means for returning this water may, of course, be resorted to.

H are a series of suitably perforated steam injection pipes located in the bottom of the tank, preferably below the aforesaid steam gangs, and in communication through a series of feeders *h* with a steam supply pipe I, conveniently leading directly to the boiler.

It will be observed from a comparison of Fig. 1 with Figs. 2 and 3 that the arrangement of the various pipes in the region where they lead into the tank is not the same in all the figures; the difference, however, is one of mere detail, and resorted to for clearer general illustration.

The gangs of steam pipes represented are typical merely of an arrangement of steam pipes within the tank through which steam may be caused to circulate, and among or around which the lumps of crude asphalt are introduced and subjected to the heating action of the circulating steam.

The perforated steam injection pipes and their feeders represented are also typical merely of a convenient steam injecting device through the instrumentality of which the mass of asphalt is agitated during the period of its subjection to the heating action of the steam in the gangs of heating pipes.

I make no claim upon the apparatus, as such, and the details of the apparatus shown may be varied at the will of constructer.

I have not deemed it necessary to illustrate my devices for agitating by steam in connection with a tank or kettle adapted to be heated for the refining of the charge by the direct application of flame,—for the reason that such kettles are in themselves well known, while any workman can readily apply to them such steam injection pipes as I have shown and described in connection with a kettle equipped with gangs of steam heating pipes,—and for the further reason that I prefer to apply my invention in connection with apparatus equipped with steam heating pipes and not adapted to be heated by fire.

Having now described the process in which my invention resides, and an apparatus conveniently adapted to effectuate it, it is proper for me to add, that, although apparatus of kindred character has been employed in operations of rendering and refining oils, fats, and similar substances, yet that my process is confined to the treatment of natural asphalt, a substance in its nature and uses dissimilar to any substance heretofore treated by kindred operations, and that as applied to asphalt the purpose of my treatment, the effect of it upon the material, and the resulting product, are all essentially new in the art, and the result of continued and protracted experiments. In a word, natural asphalt being a, so to speak, mechanically produced emulsion composite of thermal water contain-

ing a large percentage of various salts, and of various hydrocarbons, earthy matter, and non-bituminous carbonaceous organic matter,—the methods heretofore, except by Wilkinson, universally adopted for refining or preparing it for use as a base for asphaltic paving cements, have been by fire applied, either directly or through partially protecting surfaces of fire brick, to the vessel containing it, and the material thereby invariably produced has been one inferior in all essential qualities requisite for every purpose to which it is put, to that produced by my process.

Having thus described my invention, I claim and desire to secure by Letters Patent—

The process of refining natural asphalt, which consists in subjecting it in an open tank or vessel, in its crude state, and while under subjection to the action either of steam or of fire heat, to the heating and agitating influence of steam disseminated throughout it by direct injection, substantially as and for the purposes set forth.

In testimony that I claim the foregoing as my invention I have hereunto signed my name this 31st day of May, A. D. 1893.

RICHARD D. UPHAM.

In presence of—
J. BONSALL TAYLOR,
F. NORMAN DIXON.