I recognize the fact that the time allowed for duration of the Bowers patents is running, and, if he is to have the benefit which the patent laws were intended to confer upon inventors, his rights should be protected during the life of his patent. In a closely contested case several years must necessarily pass before a final adjudication in a court of last resort can be expected. The circuit court of appeals gave to the Bowers patents a broad construction, and held machinery constructed according to the specifications of the Von Schmidt patents to be infringements. In comparing the different machines, it is very difficult for me to find infringement in the Von Schmidt machine, and not in the dredger Oakland. Upon this hearing it has been shown that part of the public work which the defendants have under contract to be done by use of the Oakland, has been completed, and, upon giving a bond for damages, what remains may be completed, so that there is not the danger of serious loss and irreparable injury to the defendants and inconvenience to the public which at the time of the first hearing appeared to exist. It is plain that the complainants are threatened with and likely to suffer irreparable injury by competition in bidding for work during the short time remaining before their rights under the Bowers patents shall expire, if during that time their competitors shall be free to use such a machine as the dredger Oakland. These considerations have led me to the conclusion that justice and equity require the granting of the application for an injunction at this time, with provisions for protecting rights which may be found in the defendants by requiring the complainants to execute a bond with sufficient sureties, conditioned to pay all damages caused by the injunction, if it shall be finally adjudged to have been improvidently issued. The work under contract at Everett and Swinomish slough, however, will be excepted from the injunction if the defendants will give a bond in the sum of $5,000, conditioned to secure payment of any damages which the complainants, or either of them, may recover on account of said work.

VON SCHMIDT v. BOWERS.[1]

(Circuit Court of Appeals, Ninth Circuit. January 4, 1897.)

No. 232.

1. PATENTS—VALIDITY—INFRINGEMENT.
   The Bowers patents, No. 318,859 and No. 355,251, for hydraulic dredging machines, construed, and *held* valid and infringed as to claims 10, 16, 25, 53, 54, and 59 of No. 318,859, and claims 13, 17, and 18 of No. 355,251, by machines constructed under the Von Schmidt patents, No. 277,177, No. 300,333, and No. 306,368. Bowers v. Von Schmidt, 63 Fed. 572, affirmed.

2. SAME—EXTENT OF CLAIMS—PIONEER INVENTION.
   The Bowers patents disclose and cover inventions of a pioneer character standing at the head of the art, and their claims are entitled to a broad and liberal construction.

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[1] Rehearing denied.

8. SAME—FUNCTIONAL CLAIMS.
Said claims are not functional in form, nor are they claims for results, nor are they limited to any particular form of construction of the elements which make up the combinations, but they are broad generic claims, without any limitation as to the form of construction of the particular elements; and all subsequent machines which employ substantially the same means to accomplish the same result are infringements, notwithstanding the subsequent machine may contain improvements in separate mechanism which go to make up the machine.

4. SAME—AGGREGATION.
The Bowers claims are not mere aggregations, because the result produced is the product of the combination in which each element affects the action of all the others, and all of the elements co-operate in the one result of severing by the forward and side action of the machine the material in place where it is not wanted, and depositing it in another place where it is wanted.

5. SAME—GENERIC AND SPECIFIC CLAIMS.
A pioneer inventor is entitled in his patent to a generic claim, under which will be included every species of the genus; and, in addition thereto, he is entitled in the same patent to make specific claims for one or more species of the genus.

6. SAME—ROTARY EXCAVATOR WITH INWARD DELIVERY.
The terms "inward delivery," in a claim for an excavator, have direct reference to the mechanism itself, and cannot properly be limited to the description or effect of such mechanism. The clear meaning of a claim to "an excavator having inward delivery" or "with inward delivery through itself" is an excavator so constructed as to produce an inward delivery.

7. SAME—VON SCHMIDT EXCAVATOR.
The Von Schmidt excavator shown in his patents Nos. 277,177 and 300,333 is a rotary excavator with inward delivery to a nonrotating suction pipe, within the above definition.

8. SAME—ORIGINALITY OF BOWERS' INVENTION—DATE OF SAME.
Bowers did not derive the ideas contained in his patents from Von Schmidt, or any model or machine of Von Schmidt, but he was the original and first inventor thereof, and the date of such invention is July 13, 1864.

9. SAME—ANTICIPATION—TIME OF.
The defense of anticipation, to be successful, must be established as of a date anterior to the patented invention, not merely prior to the application for or date of the patent.

10. SAME—EARLY DRAWINGS AND MODELS.
As against the defense of anticipation, the patentee may show the fact of invention by drawings, sketches, models, or any other competent proof.

11. SAME—ABANDONMENT—REASONABLE DILIGENCE—STANDARD OF PROOF.
Delay in applying for a patent after an invention is made will not constitute abandonment, where the inventor has used reasonable diligence to perfect the invention, and avail himself of its benefits; and there is no general standard by which such diligence is to be established, but it must be reasonable under all the circumstances of the particular case. Tested by this rule, *held*, that Bowers did not abandon his invention.

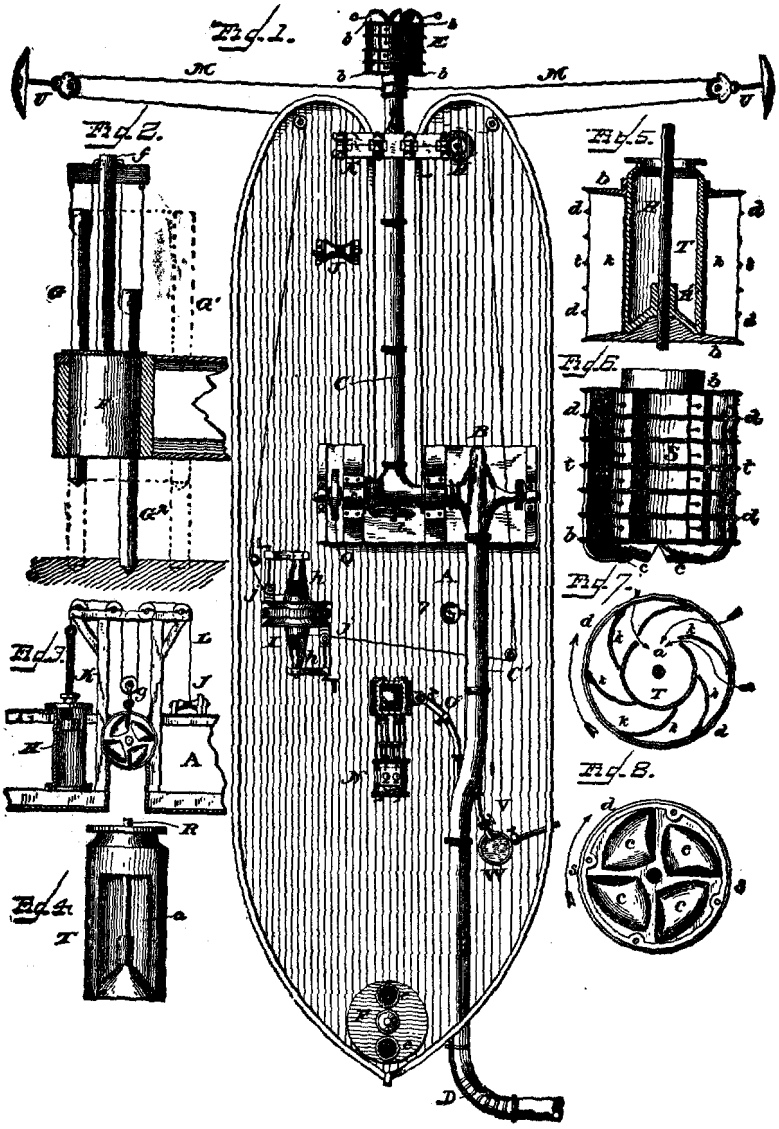
12. SAME—FAULT IN ORIGINAL MACHINE.
The fact that the first machine built by a patentee, whose patent is sued on, was not successful in operation, is unimportant, and no reason for denying him relief, especially where his subsequent machines have proved successful in practice.

Appeal from the Circuit Court of the United States for the Northern District of California.

This was a suit in equity brought by Alphonzo B. Bowers against Allexey W. Von Schmidt to restrain infringement of letters patent No. 318,859, for "Dredging Machine," and No. 355,251, for "Improvements in Hydraulic Dredging Machines," both issued to Alphonzo B.

Bowers,—the first on May 26, 1885, and the second on December 28, 1886. The lower court sustained both patents, and found infringement of claims 10, 16, 25, 53, 54, and 59 of patent No. 318,859, and of claims 13, 17, and 18 of No. 355,251. 63 Fed. 572.

The following are copies of the drawings annexed to the patent No. 318,859:



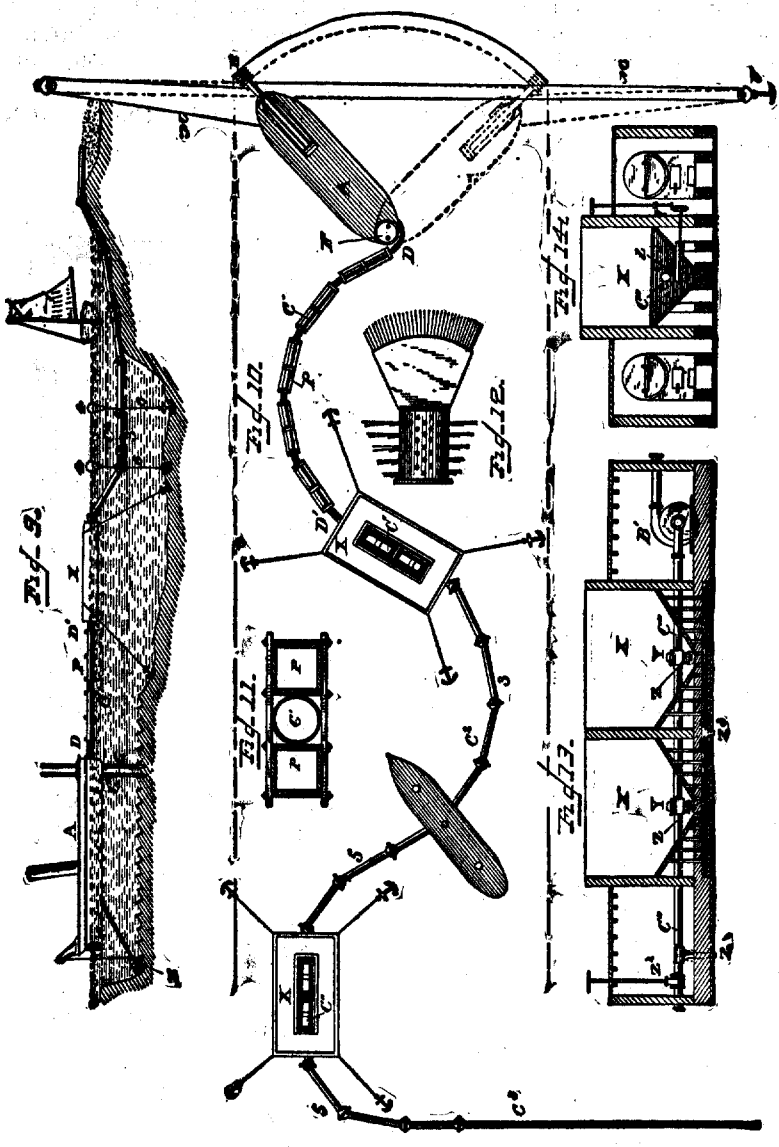


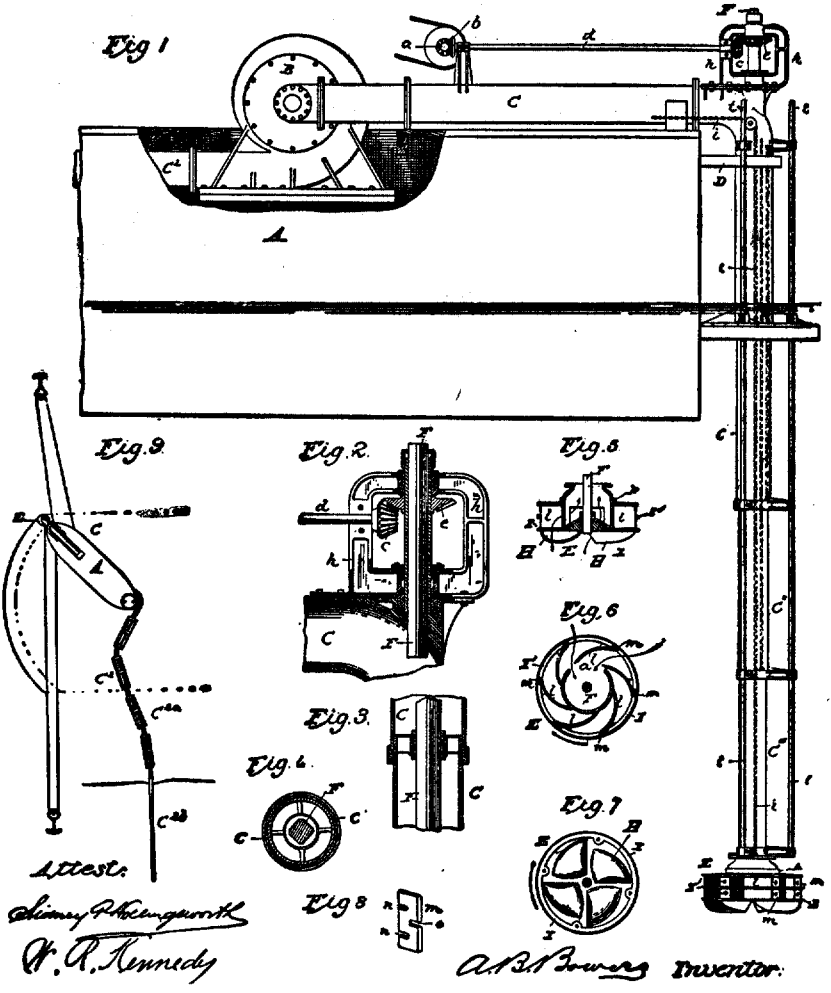
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.

The following are copies of the drawings annexed to letters patent No. 355,251:

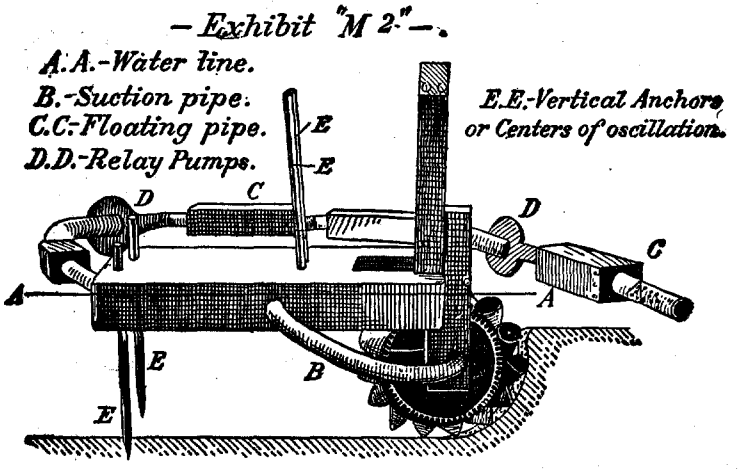
(No Model.) A. B. BOWERS.

HYDRAULIC DREDGING APPARATUS.

No. 355,251. Patented Dec. 28, 1886.



The following are photographic reproductions of Exhibits M², M, N, and II, referred to in the opinion, being photographs of four models made by Bowers in 1868:



Model Exhibit "M?" made in Feb. 1868.

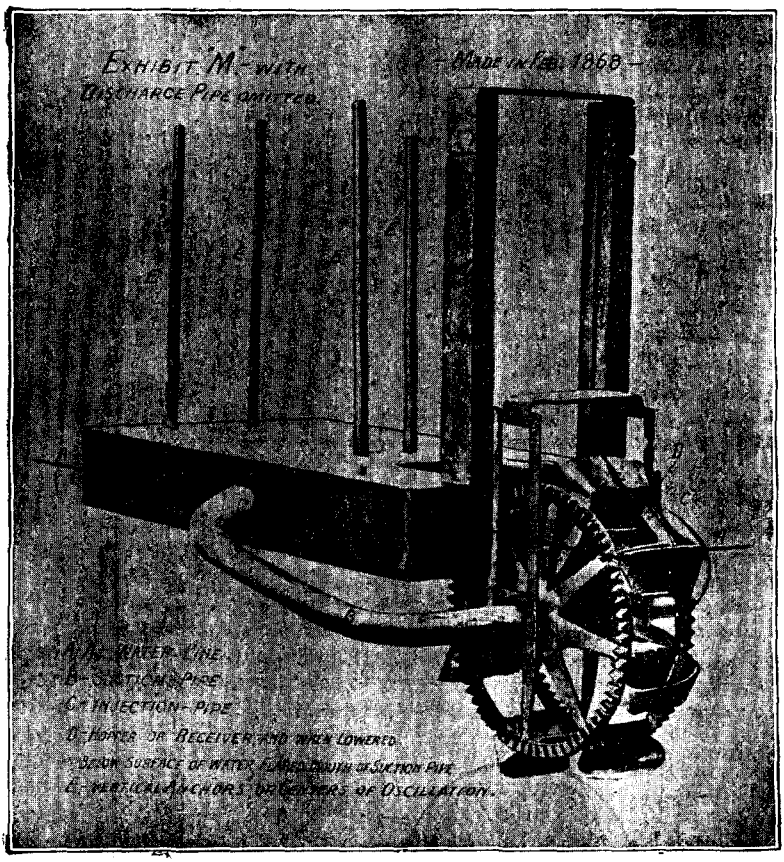
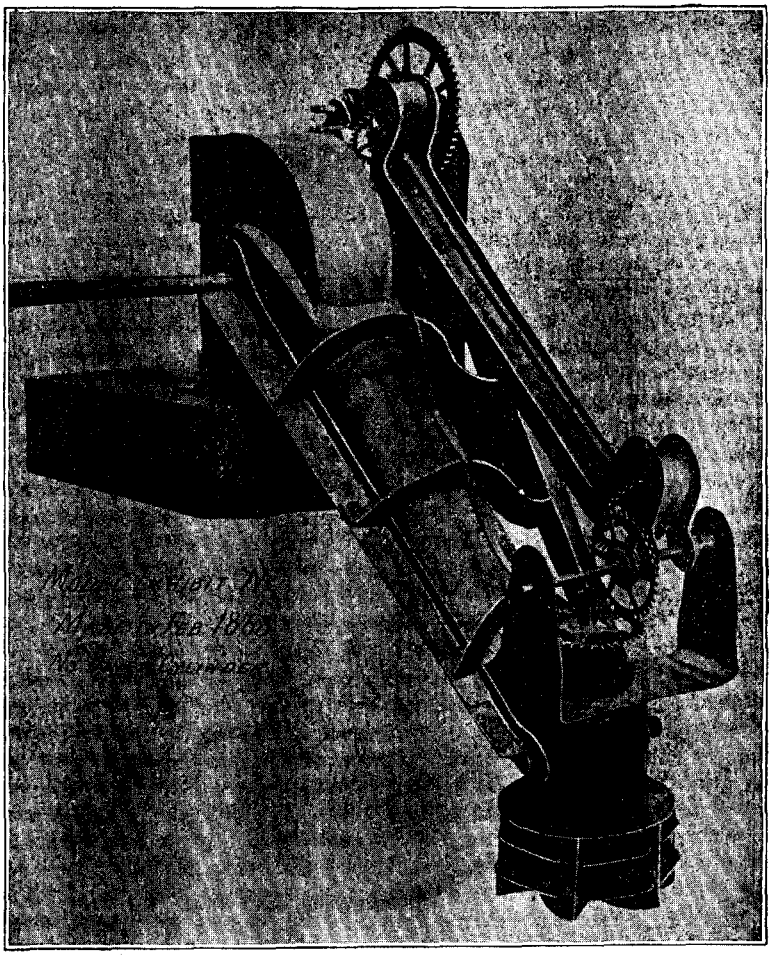
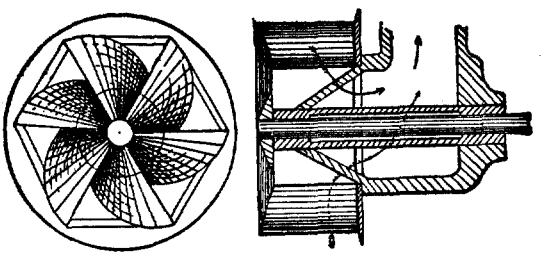
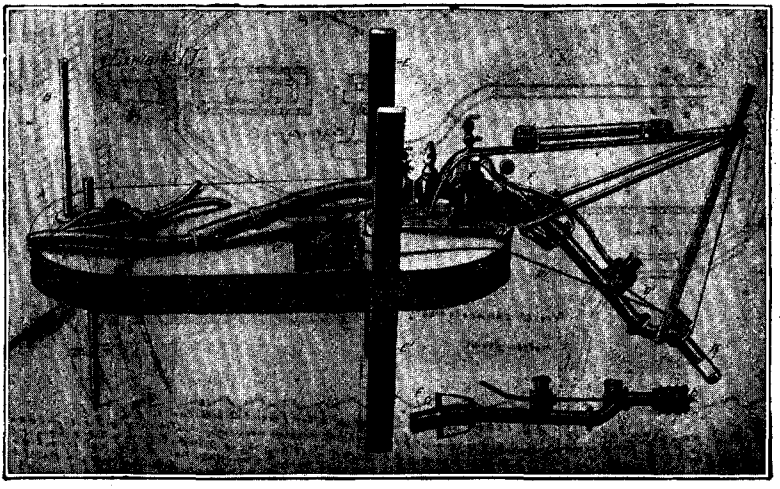


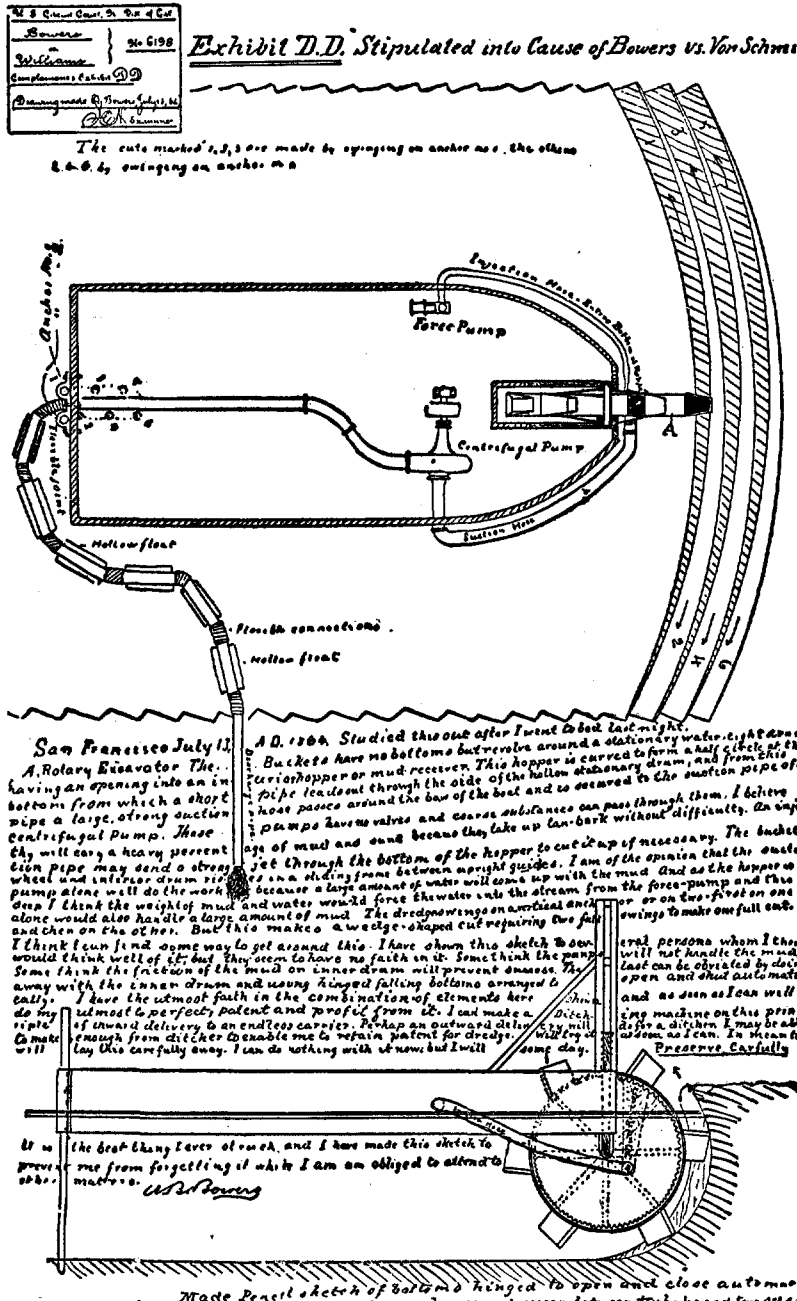
EXHIBIT "M" WITH
DISCHARGE PIPE OMITTED.
MADE IN FEB. 1868
A-A. WATER LINE.
B-SUCTION PIPE.
C-INJECTION-PIPE.
D-BOILER OR RECEIVER AND WHEN LOWERED
SHOWS SURFACE OF WATER & ANGLE BELOW OF SUCTION PIPE.
E. PERPENDICULAR ANCHORS OR GUIDES OF OSCILLATION.



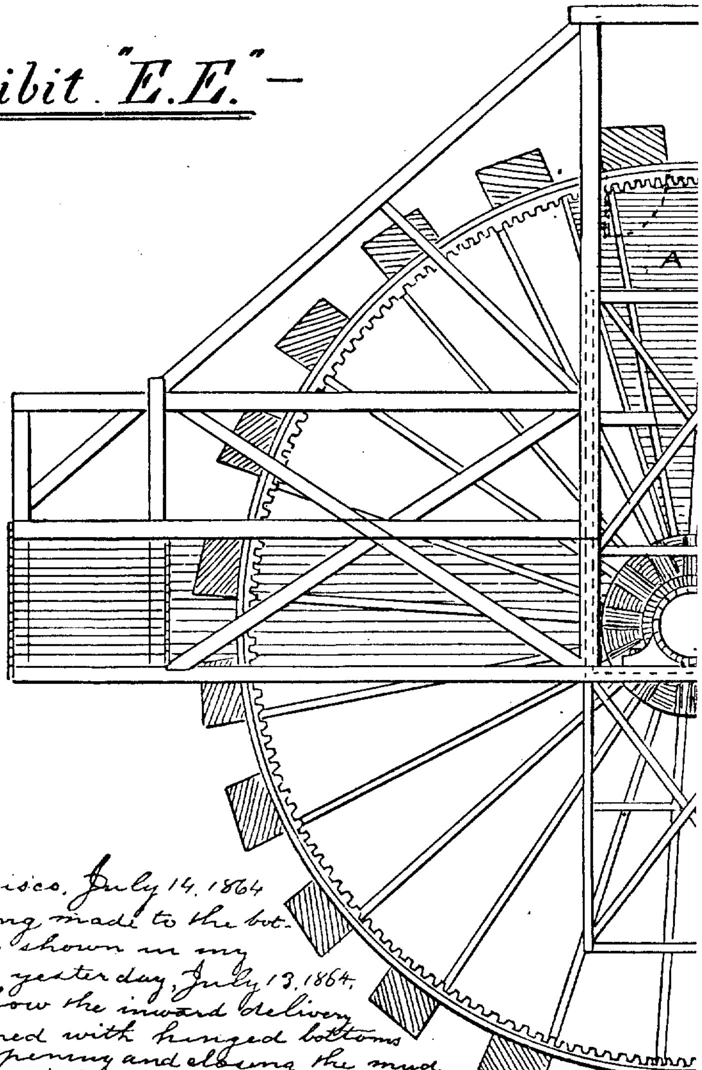




The following are copies of the drawings and memoranda referred to in the opinion as Exhibits DD and EE, being original drawings made by Bowers on July 13, 1864, and July 14, 1864, respectively:



- Exhibit "E.E." -



I wish I could do so at once but as this is impossible, I retain this sketch to prevent me from forgetting the details

A. B. Bowers.

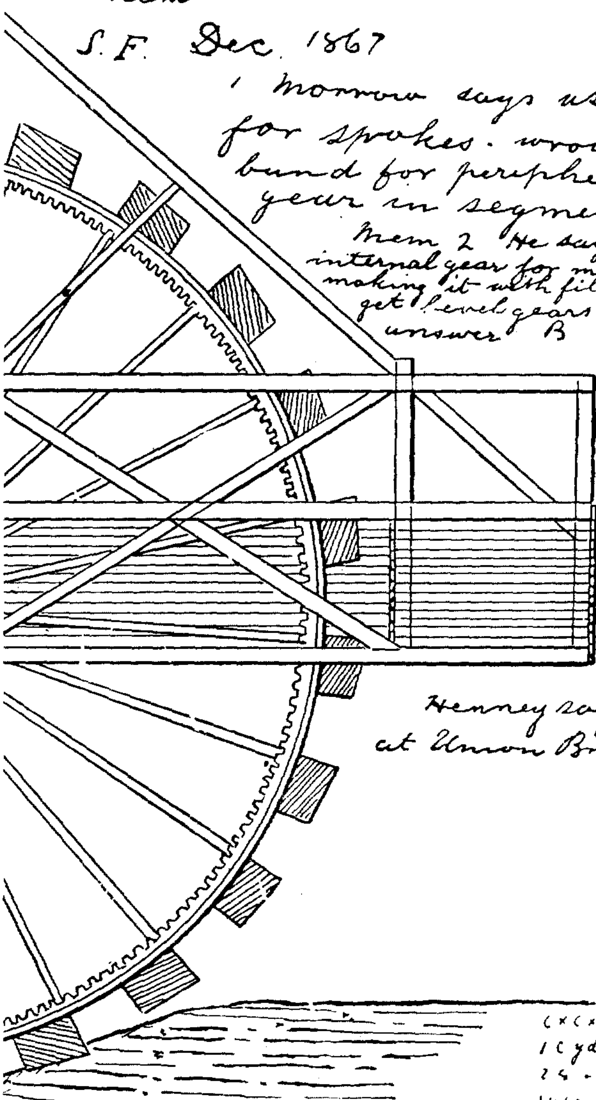
San Francisco, July 14. 1864
Objections being made to the bottomless bucket shown in my sketch made yesterday, July 13. 1864, I here show how the inward delivery may be retained with hinged bottoms automatically opening and closing the mud being dumped into a stationary receiver (between the spokes of the wheel) emptying through a slot in a large hollow axle into one end of w
be injected for carrying away the mud without pe
receiver, A, being high enough above the pipe, or stationary ho
column to prevent egress of water through the receiver &
which a discharge pipe or hose is flexibly conne
carried in this way a relay centrifugal pump ma
sion, as this pump having no valves will allow the passa
of spokes, but the same principles may apply to a wheel w
I believe the principles involved in these sketches are valuable and I sh
out and apply for patent as soon as circumstances will permit

Mem.

S.F. Dec. 1867

1 Morrow says use gas pipe for spokes. wrought iron band for periphery & make gear in segments.

Mem 2 He says I cant get suitable internal gear for model without making it with file and I will try to get bevel gears as they will answer. B



Henney says get gears at Union Brass Works B.

6×6×18 = 648 ft.
16 yd pr bucket
24 " minute
1440 yd pr hour
Discharge through hollow axle.

... stream of water may
... it through the pump, the
...le to serve as a pressure
...the mud into the hollow axle to the other end of
...f it is desired to carry mud further than it can be
...nnected with the discharge pipe for renewed propul...
...mud and water. This wheel has two hubs and two sets
...ingle hub as in yesterdays sketch with bottomless buckets.

M. A. Wheaton, for appellant.
John H. Miller, for appellee.

Before GILBERT and ROSS, Circuit Judges.

ROSS, Circuit Judge (after stating the facts as above). This was a suit for the infringement of certain claims of certain letters patent. By his amended bill of complaint the complainant alleged that prior to December 9, 1876, he was the original and first inventor of certain new and useful inventions in dredging machines, machinery, and appliances, which were not known or used in this country, nor patented, nor described in any printed publication in this or any foreign country, prior to the inventions thereof by the complainant, nor had they been in public use or on sale in this country for two years prior to the complainant's application for a patent therefor, nor abandoned nor proved to have been abandoned; that, being such inventor, the complainant did, on December 9, 1876, duly and regularly make and file in the patent office of the United States an application for the issuance to him of letters patent for his said inventions, and that such proceedings were had in the matter of his application that on April 18, 1877, his application was allowed, and a patent for his said inventions ordered to be granted and issued to him upon the payment of the final fee to the government of $20 within six months from the date of said allowance; that the complainant failed to pay the fee within the time stated, by reason of which his application lapsed; that within two years after the said 18th day of April, 1877, to wit, April 16, 1879, under and pursuant to the laws of the United States and the rules of the patent office in that behalf made and provided, the complainant renewed his application in the patent office for a patent for his said inventions, and filed a renewed application therefor, using the original specifications, drawings, and models which had been made and filed December 9, 1876, and which were then on file in the patent office; that both in his original application as also in his renewed application of April 16, 1879, more than one, to wit, several, independent inventions were described and claimed, which, upon examination by the proper examiners of the patent office, were found not to be dependent upon one another, and did not mutually contribute to a single result, by reason of which a single patent could not be issued to cover them; that thereafter, and before the issuance of any patent therefor, and in accordance with the requirements of the patent office, and under and in accordance with the laws of the United States, the complainant did divide his original application, and filed divisional applications for his said several inventions; that one of the inventions described and claimed in his original application of December 9, 1876, and in his renewed application of April 16, 1879, was entitled "Dredging Machines"; that, while his original application was pending, the complainant prepared and filed in the patent office a separate divisional application, describing and

claiming his improvements in dredging machines; that nothing was included in his divisional application which had not been shown and described in his original application of December 9, 1876, and renewed April 16, 1879; that thereafter such proceedings were duly and regularly had and taken in the matter of his application that on May 26, 1885, letters patent of the United States, numbered 318,859, were duly and regularly granted and delivered to the complainant for his said invention, granting and securing to him, his heirs and assigns, for the term of 17 years from that date, the exclusive right and privilege of making, using, and vending the invention therein described throughout the United States and its territories; that one of the complainant's inventions, shown and described in his original application of December 9, 1876, and renewed April 16, 1879, was a certain new and useful invention, entitled "Hydraulic Dredging Apparatus"; that while his original application was pending, to wit, August 3, 1886, the complainant filed in the patent office a divisional application for the issuance of letters patent for said hydraulic dredging apparatus; that nothing was included in his last-mentioned divisional application which had not been shown or described in his original application of December 9, 1876, and renewal of April 16, 1879; that such proceedings were duly and regularly had and taken in the matter of his divisional application for a patent on said hydraulic dredging apparatus that on the 26th day of December, 1886, letters patent, numbered 355,251, were regularly granted and delivered to the complainant for his said invention, granting and securing to him, his heirs and assigns, for the term of 17 years from that date, the exclusive right and privilege of making, using, and vending the invention therein described throughout the United States and its territories, of both of which patents, and of all rights and privileges conferred thereby, the complainant alleged he has since remained the owner and holder, and both of which patents the amended bill alleged the defendant has infringed.

The answer of the defendant to the amended bill of complaint put in issue its material averments, and also pleaded in defense of the suit, among other things, the abandonment by the complainant for more than two years of his original application for a patent, and alleged that the patent office, unlawfully and in excess of its powers, allowed the complainant to renew his application more than two years after such abandonment. The answer further alleged a want of due diligence in the prosecution of the complainant's application, and averred that on June 14, 1882, and October 16, 1884, the complainant struck out all of the specifications in his application on file in the patent office at each of those dates, and inserted in lieu thereof, in each instance, other and different specifications, describing other and different inventions, of which he well knew he was not the inventor, and that he also withdrew from his original application all the drawings filed therewith, and substituted other and different drawings therefor; that the de-

scriptions, drawings, and claims in the patents issued to the complainant were changed from the descriptions, drawings, and claims contained in his original application, for the express purpose of including in and covering by his patents inventions and improvements which were made by and belonged to parties other than himself; that, in accordance with the complainant's original drawings and specifications, no useful or operative dredging machine can be constructed; and that, upon a fair and adequate trial, a machine so constructed has been proven to be useless; and that it is only by reason of changes and modifications and omissions in the drawings and specifications under the complainant's original application, and an appropriation of the inventions and improvements of others, that there can be constructed, if at all, any operative dredging machine in accordance with the divisional applications of the complainant. The answer further averred that the defendant filed an application in the patent office on the 3d day of July, 1876, upon which his patent numbered 185,600 was granted to him December 9, 1876; that he made the plans of his dredger for which such patent was issued to him in the year 1874, and made a model thereof in April, 1875; that in 1875 and 1876 he built a dredging machine, which embraced the inventions described in his patent numbered 185,600; that in 1882 he built the hull of a new dredging machine, and finished the same by using a large part of the machinery which was put into his first dredger; that his second dredger contained the same inventions that were contained in his first; and that these two dredgers are the only dredging machines that the defendant has ever constructed or used or sold in the state of California. The answer further averred that the complainant saw and examined the defendant's model of his first dredging machine, and from that model obtained his (the complainant's) first idea of a suction dredger; that both dredgers made by the defendant were suction dredgers, and were operated by a rotary pump, and a telescoping suction pipe, with a rotary excavator having an internal delivery at the bottom of the suction pipe, and also had connected therewith a floating conveying pipe, through which the spoils were carried and deposited at a distance of a mile from the dredger; that the complainant from time to time examined and studied the defendant's dredger, and its mode of operation, and made sketches thereof, after which the complainant made his new applications for letters patent, and changed his drawings and specifications on file in the patent office, and purposely framed them so as to cover the dredging machinery and apparatus of the defendant; that in the patent office the complainant was referred to the patent of the defendant, and changed his claims so as not to include the defendant's inventions, and thereby avoided having an interference declared with the defendant in the patent office. The answer to the amended bill also set up various patents and publications as matters anticipating the complainant's alleged invention, and also alleged that the complainant kept the

same on sale for more than two years before his application for a patent therefor, and also averred that the patents issued to the complainant contained a needless multiplication of nebulous claims, thereby rendering the patents void, and also that the claims in each of the complainant's patents purport to cover general combinations which may be included in general definitions and in general terms of description, and also cover what is not described in his specifications.

The foregoing constitute in substance the defenses set up in the answer to the amended bill. Exceptions to certain portions of the answer were sustained by the court below, which rulings constitute the first 23 of the 57 assignments of error filed by the appellant; but as his counsel state in their brief that they "do not insist upon them unless the complainant claims that the material testimony taken should not be considered for want of a pleading," and as there is no such insistence on the part of the complainant, no further reference need be made to the exceptions.

The record in the case is very voluminous, embracing 2,477 printed pages, and including a vast number of exhibits. The arguments of counsel are elaborate and able, and while they have been carefully considered, and all of the points made attentively noted, it is not practicable to make special mention of them all, without extending this opinion beyond reasonable limits. The patent granted to the complainant May 26, 1885, and numbered 318,859, contains 103 claims; and that issued to him December 28, 1886, and numbered 355,251, contains 22 claims. The court below found infringement by the defendant of claims 10, 16, 25, 53, 54, and 59 of complainant's patent 318,859, and of claims 13, 17, and 18 of his patent 355,251. In the specification contained in his first patent, the complainant states that his invention—

"Consists of a rotary bottomless bucket excavator wheel, of moderate size, novel construction, and great capacity, combined with a hydraulic transporting device of equal capacity, by means of which the spoils may be cheaply carried to a distance of several miles over land or water and across navigable channels, without interruption of navigation, together with novel feeding devices, through which the percentages of earth excavated by the cutting wheel and of the water therewith delivered are adjustable to the precise amount of each necessary for most economical working, and by means of which clean work is done, the excavator going twice over no ground, and missing no ground; thus saving much time, and effecting a material reduction in the cost of apparatus, repairs, and cost of dredging and of disposing of the spoils, these being the chief objects of the invention."

And, referring to the accompanying plans and the figures thereon, the complainant thus described his machine and its operation:

"A is a floating vessel that carries the engines, boilers, and dredging machinery. It is shown in this instance with an elongated longitudinal well for the reception of the swinging portion of the suction pipe.

"B is a large pump that draws the spoils from the buckets of the excavator up the suction pipe, and forces them through the discharge pipe to a place of deposit.

"B', Figs. 9, 13, is a relay pump or other auxiliary discharging apparatus, sometimes used in connection with a primary transporting apparatus to carry

the spoils to a greater distance than could conveniently be done by the original agent, power, or pump, or than would be practicable without subjecting the apparatus to a pressure that might endanger some of the parts, or without the use of heavier or more expensive apparatus than would be desirable for ordinary purposes. It may also be used for discharging the receiver, X, and for exhausting water from pipe C' (when said pipe is submerged), for the purpose of raising it, preparatory to floating it into a new position. As many of these pumps may be used as are necessary to transport the spoil to the required distance.

"C is a suction pipe connecting the excavator with the pump B. The swinging portion of this pipe is mounted at the inner end of the well upon strong trunnions, one of which forms an elbow of the pipe, and passes through a stuffing box or other suitable connection into the suction pipe of the pump B. Through the other trunnion passes a shaft that actuates the gears, I, that drive the shaft, R, and bucket wheel, E; and upon these trunnions the shaft, R, suction pipe, and excavator swing as the cutter is raised or lowered to suit the depth at which the work is progressing.

"C' is a discharge pipe. It is provided with a strong flexible section, D, or other suitable joint or mounting, at or near the turntable, F, and other pivot or center of oscillation of the dredging machine or excavating apparatus, and is constructed and arranged to permit said apparatus or machine to swing horizontally upon said pivot or pivots without materially changing the position of said discharge pipe beyond said mounting, flexible connection, pivot, or pivots. When this pipe is several hundred feet in length, I usually support the inner portion by 8 long, narrow, hollow floats, in which case it consists of two parts,—an inner oscillating or swinging section (generally composed of several short sections flexibly joined together and to the dredge boat), and an outer stationary or nonoscillating section, flexibly joined to said inner section. This permits the boat to feed forward, and the oscillating section to swing with the advancing boat (as the work progresses) on the joint connecting the oscillating and nonoscillating sections. The discharge pipe is provided with a pressure gauge, 7, Fig. 1, to give notice of overpressure and danger of choking of pipe from any sudden change in the character of spoil. When pipe C' is above deck, and extends but a short distance from the mounting, D, for discharging alongside, it requires supporting, and is usually suspended from a mast, the claim for which is reserved for another application now on file.

"C" is a pipe passing through the receiver, X, to the exhausting apparatus of said receiver. When used in connection with the pipe C', it may be regarded as the prolongation of said pipe.

"C^2 is an auxiliary discharge pipe, used in connection with any suitable auxiliary transporting apparatus, and extends from said auxiliary to another auxiliary transporting agent or apparatus, or to the place of deposit.

"C^3, Fig. 10, is a discharge pipe extending from a second relay discharging apparatus to a place of deposit. When a floating discharge pipe would impede navigation, the greater portion may lie upon the bottom, 4, Fig. 9; and, when the water is too deep for this, it may be suspended from the buoys, 5, 5, Fig. 9, and guys and anchors, 6, may, if necessary, be used to prevent it from being disturbed by winds, waves, or currents. When the pipe is to be submerged, it may be advisable to construct it of thin metallic plates, uniting the several sections with ball and socket or other strong flexible connections. In other cases it may be made of wood or metal, according to the preferences of the user.

"E is a rotary bucket-wheel excavator, having radiating bottomless buckets, k, Figs. 4, 5, 6, 7, firmly secured at each end to the discal ends, b, b, of said excavator. These buckets may be stiffened, strengthened, and protected by rings or screens, d, passing around, secured to, and preferably projecting beyond the edges of, said buckets, Figs. 1, 5, 6, 7, 8. These rings may be sharp to cut like the revolving disk colters of plows, and serve to subdivide the material entering the buckets, and to exclude substances too hard to be cut and too coarse to pass through the pipe and pump. They serve also as fenders to enable the cutter to ride over obstructions without catching and breaking.

The edges of the bucket are sharp, and may be provided with detachable steel knives or cutters, S, Fig. 6, for working in hard material. The outer discal end, Figs. 1, 3, 6, 8, may be provided with cutting edges, lips, or scoops, c, to obviate the danger of breakage from jamming against a hard bank, as the dredger heaves in the swell of the sea. In making the necessary openings in the discal end to admit the silt from said scoops, said end plate becomes changed to the form of a spider or series of arms, which may be strengthened by the lower ring, d, which, in turn, may be regarded as forming a series of braces extending between the said arms at or near their outer parts. The several parts of this excavator may be made separate and detachable, or it may be cast in a single piece. I do not confine myself to the precise mode described of mounting this wheel, or of freeing it of its contents. It may be of any desired size and proportion of parts, and may discharge its contents inward through itself into any suitable conduit or receiver. The rings, d, may be omitted in soft mud, free from substances too coarse to pass through the pipes and pump, though always at the risk of the projecting buckets catching upon obstructions, and getting broken.

"F, Figs. 1, 2, 10, is a small cylindrical turntable, rotating in a circular well or frame. It is provided with a strong flange or other suitable bearing, and is rotated in any convenient manner. Two or more vertical apertures, e, e, pass through the turntable from top to bottom on opposite sides, as shown.

"G, G^2, are vertical anchors passing loosely through the apertures, e, e, in the turntable, into the mud below. They are raised by blocks and tackle attached to the mast, f, or in any other usual manner.

"H is a counter balance cylinder, connected with the suction pipe, excavator, and hoisting apparatus, to obviate the danger of breakage from pounding upon the bottom in a heavy swell. It is provided with a piston, piston rod, and gland, like a steam engine. Steam or compressed air is admitted to the upper side of the piston, the area of which is sufficient very nearly to balance under the given pressure the weight of the suction-pipe and excavator. To the upper end of the piston is attached the hawser, L, passing over suitable sheaves in the frame, K, thence through the block, g, Fig. 3, whence it passes over other sheaves in said frame to the windlass, J, by which means the excavator can be raised or lowered by said windlass without interrupting the action of the counter balance. When the dredger rises on a swell, the excavator rises also; and, as the dredger sinks in the trough of the sea, the excavator falls upon the bottom, not with the full weight of the excavator and suction pipe, but with the unbalanced weight only, striking so lightly as not to endanger the safety of the wheel. This device is necessary only when dredging a hard bottom in a heavy swell. When not required for this purpose, the cylinder, H, may be utilized as a steam or hydraulic hoist, or be dispensed with altogether.

"I is a variable winding device, of which there are many suitable forms. I prefer ordinary winding drums driven by a separate engine, though, for simplicity of illustration, I have shown tapering drums, h, h, loosely mounted on a shaft, and driven (through V-shaped friction couplings and suitable connections) by the main engine. The disengaged drum gives out one warping line, as the engaged drum takes in the other. The office of this device is to vary the speed of the side feed, for the purpose of regulating the percentages of earth and water delivered to the pump, without affecting the speed of other parts of the machinery. This speed, with the device shown, is dependent upon the diameter upon which the warping lines wind, and is varied by shifting the sliding guide sheaves, j, j, towards or from the larger ends of the drums, by means of the hand wheels and screws, as shown.

"J is a windlass for raising and lowering the excavator.

"K is a frame from which the suction pipe and excavator are suspended.

"L is a line or chain for raising, lowering, and counter balancing the excavator.

"M, M, are warping lines passing from the hold to the winding drums, h, h, around which they make a sufficient number of turns to prevent slipping, whence they pass around suitable guide sheaves, to and through the anchored blocks, U, U, to the outer end of the suction pipe, to which they are secured,

so that the working side-strain falls mostly upon the outer end of the suction pipe (or of the ladder supporting said suction pipe, if such be used), and but lightly upon the joints or trunnions supporting the inner ends of said pipe or ladder. As the outer ends of these lines wind upon the drums in the device shown, the inner ends unwind and descend to the hold. The office of these lines is to swing the excavating apparatus or the dredger from side to side in the process of dredging, and firmly to anchor the excavator end of the dredger when it is not at work, which latter is accomplished by simply engaging both drums, h, h, in their friction couplings.

"N is a force and suction pump. It is used to exhaust the water from the discharge pipe for the purpose of raising the submerged portion, to dilute the spoils, so that they will spread over a large area of land, or to enable them to be transported through long pipes without the aid of a relay pump, to clear the pipes when accidentally choked, should this ever occur, and to prime the pump B; the latter or its suction pipe being provided with the usual valve or valves for that purpose. Like most steam pumps, it is provided with two suction orifices on opposite sides of the water chamber, and a discharge directly over each suction. To the suction and discharge on one side is connected the branch pipe O, leading into the pipe C'. Each branch is provided with valves in the usual manner of arranging a branch pipe to serve for suction and discharge. The discharge branch only is shown, the suction being directly under it. To the suction on the other side of the water chamber is secured a valve and pipe communicating with any suitable supply of water (usually that in which the dredger floats), and sometimes by a branch pipe and valve with the hold of the vessel for discharging leakage, and by another branch and valve, with pump B, for priming said pump by suction. To the discharge above this suction is connected a pipe or hose, that may also be used for priming the pump B by discharging into it, and for all the various purposes of an ordinary ship pump. When O is used as a suction pipe to draw from pipe C', the valve on the discharge branch is closed, the suction-branch valve is opened, and the discharge is through the pipe or hose on the opposite side. When O is used as a discharge pipe to force into pipe C', the suction-branch valve is closed, the discharge-branch valve is opened, and the suction is through the opposite suction pipe. When the suction is through the pipe opposite the suction branch of pipe O, the discharge may be through the pipe or hose above it, or through the discharge branch of O into pipe C', as regulated by the valves to suit the purposes of the user.

"O is a pipe with branches and valves connecting both suction and discharge on one side of the pump N with pipe C', and is either a suction or discharge pipe, as regulated by its valves.

"P, P, are long, narrow, hollow floats, preferably extending longitudinally along each side of the short sections of the discharge pipe, for supporting them on the water. They may be made of wood or metal, and be secured together and to the discharge pipe by pieces of scantling passing crosswise over and under the pipe and floats, and fastened with rods passing each side of the pipe and floats, as shown in Fig. 11, though I do not confine myself to this form of construction.

"Q is a pulley or gear for actuating the gears, i, and excavator, E. It may be connected with its shaft by a friction coupling.

"R is the driving shaft of the bucket wheel. It is keyed or otherwise secured to the hub of the wheel, whence it passes through suitable bearings in the inner chamber, up the suction pipe, and through a stuffing box to the gears, i, by which it is actuated.

"S is a strong detachable steel knife, sometimes used on the edges of the buckets when working in hard material. It may be serrated, chisel-toothed, or straight-edged, according to the character of the materials to be cut, a straight edge being preferable for ordinary work.

"T is an inner chamber or shield, around which the bucket wheel revolves, and into which it discharges. This chamber is provided with a strong flange, by which it is secured to a similar flange on the end of the suction pipe. It is also provided with a large opening, a, Figs. 4, 7, through which the spoils

enter from the buckets, and through this opening, Fig.4, is seen a portion of the driving shaft, R, and the bearing of said shaft in the end of said chamber. This chamber or shield forms a bottom for the buckets, k, until they reach the opening, a, as shown in the cross section of the wheel and chamber, Fig. 7. As the buckets pass this opening, they discharge mud and water into the chamber, as indicated by the inner arrows, the outer arrow showing the direction of rotation. The office, in part, of this chamber or shield, is to prevent too large a percentage of water from entering with the mud; but when the spoils are of a character to require a large percentage of water to carry them up the suction pipe, or to send them through the discharge pipe, as may sometimes be the case, the chamber may be cut away until only enough remains to support the excavator and shaft, R.

"U, U, are blocks anchored at suitable points on each side of the dredger, through which pass the warping lines, M, M, for the purpose of swinging the dredger or the excavating apparatus from side to side. They are usually placed from three hundred to six hundred feet apart, and a little in advance of the ends of the first cuts made by the excavator, to allow a wide swing, and avoid the necessity for two frequent change of place as the work progresses.

"V is a branch pipe and valve, through which samples of the spoils are drawn from the discharge pipe, to enable the operator properly to regulate the speed of the side feed. It is preferably placed about one-third the diameter of the discharge pipe from the lower side of said pipe, in order to secure a fair average sample.

"W is a small tank resting upon scales. It is provided with a discharge pipe and valve. It is filled with spoils drawn from the discharge pipe through the branch and valve, V, and the speed of the side feed is increased or diminished according to the weight of the spoils.

"X is a floating mud receiver carrying the relay pump or other auxiliary discharging apparatus, B', and its actuating apparatus. The main purpose of this receiver is to permit the excavator to run continuously, although the relay pump be stopped for a little while, the receiver affording a receptacle for the spoils in the meantime. Longitudinally through this receiver passes the pipe C'' to the auxiliary discharging apparatus, B', whence the pipe C^2 extends to another auxiliary discharging apparatus, or to the place of deposit.

"Y is a valve on the pipe C'', within the receiver, X. This valve is adjusted to open automatically outward with slight pressure, and serves as a relief valve in case of stoppage of the pump B' while the pump B is running. It serves also as a guide to regulate the speed of pump B', which should be increased beyond that necessary for preventing the opening of this valve in order to aid by suction as well as forcing. This valve may be set wide open for the purpose of filling the receiver, and may be securely closed when the pump B is used to force the material into the pump B' for the purpose of increasing the efficiency of the latter. It is also opened to admit air into the discharge pipe when the water is to be withdrawn therefrom by pump N.

"Z is a branch and valve through which mud is drawn from the receiver to be discharged through the pipe C^2.

"Z' is a branch and valve for admitting water to wash out the pipe C^2 after the mud has been discharged from the receiver.

"Z^2 is a valve for closing the pipe C'' while the mud receiver is being discharged, or when said receiver is disconnected from the pipe C', and takes the mud directly from the dumping or dredging apparatus.

"Z^3 is a pipe and valve used for admitting water through the bottom of the receiver for the purpose of diluting the mud when it is too stiff to pass freely up the branch Z. It may have branch pipes with numerous small openings for the more thorough dilution of the spoils. This receiver may be used in connection with any dredging apparatus for continuous transportation of the spoils through pipes as the work progresses; or it may be filled, towed to the place of deposit, and there be connected with a discharge pipe for putting the spoils on shore.

"The operation of dredging is as follows: The vertical anchors and excavator being raised to allow freedom of motion, the dredger is placed in position with the turntable in line with the longitudinal axis of the proposed cut. The turntable is then rotated until the vertical anchors are also in line with said axis, and both anchors are then dropped into the mud. The discharge pipe is placed in position, the blocks, U, U, anchored at suitable points for swinging the machine, and the dredger swung around until the excavator reaches the side of the proposed cut, as shown in Fig. 10. The lines, M, M, are drawn taut, and the excavator lowered below the surface of the water. The pump B is then primed, started, and the excavator set in motion, and lowered its entire diameter into the mud. The proper winding drum is then engaged, and the dredger, swinging on the turntable as a pivot or center of oscillation, rapidly cuts its way to the opposite side. To secure a steady side feed, the friction coupling of the unwinding drum may be adjusted to keep the unwinding line sufficiently taut to prevent the veering of the dredger with wind or tide. Upon reaching the opposite side, the winding drum is disengaged, the excavator again lowered its full diameter, the side feed reversed, and the dredger cuts back again. This process is repeated until the proper depth is obtained. The excavator is then raised above the bank in front, the anchor G raised, as shown in Fig. 2, and the turntable rotated upon the anchor G^2 until G is squarely in front of G^2, in line with the longitudinal axis of the proposed excavation, as indicated by the broken-lined outline G', Fig. 2. G is then dropped into the mud, and the work proceeds as before, the dredger having been fed forward the distance between the centers of the vertical anchors, which is fixed to correspond with the cut capable of being made by the excavator. This arrangement for feeding forward keeps the center of oscillation of the dredger coincident with that from which the arc to be cut by the excavator should be described. A less perfect forward feed is secured by placing the dredger so that the excavator is at the side, and the turntable in line with the longitudinal axis of the proposed excavation. The turntable is then rotated until the vertical anchors are in a line parallel with the transverse axis of the dredger where it is made stationary. This leads one anchor diagonally in advance of the other, the dredger lying diagonally across one-half of the line of the proposed excavation. The forward anchor is now dropped into the mud to form a pivot, upon which the dredger swings as it cuts to the opposite side. The dredger then lies diagonally across the other half of the line of the proposed excavation, the swing having brought the rear anchor to the front. This anchor in its turn is dropped to form a new pivot, and the other anchor is then raised. The dredger swings first upon one and then upon the other anchor, these anchors being alternately raised and lowered for this purpose. As this mode of feeding by swinging alternately upon two different pivots gives a wedge-shaped cut, requiring two full swings to make one full cut, it is equivalent to a loss of one-half of the time, and is used only to prevent stoppage of work when the apparatus for rotating the turntable is stopped for repairs or other cause, in which case it becomes valuable."

It will be seen from the foregoing that the fundamental elements of the complainant's patent 318,859, and of the machine covered by it, are a boat and excavator capable of working with a side feed, a nonrotating suction pipe, an exhausting and discharging apparatus, a discharge pipe, a self-contained pivot or center of oscillation, on which the boat swings from side to side while it is working, devices for swinging and for working the machine from side to side, devices for moving the machine ahead preparatory to a new cut, a floating discharge pipe when the spoil is to be transported over water, a submerged discharge pipe when the spoil is to be carried across a navigable channel without impeding navigation, and an outer stationary section of discharge pipe when the spoil is to be carried over land.

The claims of this patent found by the court below to have been infringed by the defendant are the following:

"(10) A dredge boat having a self-contained pivot forming a center of horizontal oscillation, with devices for swinging and working said boat upon said pivot, in combination with a suction pipe, exhausting apparatus, and rotary excavator."

"(16) A dredge boat and oscillating section of a conduit discharge flexibly joined to a nonoscillating section to allow said boat to feed forward, and said oscillating section to swing upon the flexible joint connecting said oscillating and nonoscillating sections."

"(25) A discharge pipe consisting of a series of sections flexibly joined together, and supported by floats, in combination with a dredger having a rotary excavator."

"(53) The combination, with a nonrotative suction pipe, of a rotary excavator having an inward delivery through said excavator.

"(54) The combination, with a dredge boat and nonrotative suction pipe, of a rotary excavator having an inward delivery through said excavator."

"(59) A rotary excavator with inward delivery, in combination with a nonrotating suction pipe mounted upon strong trunnions or equivalent joints, to permit the excavator and outer end of the suction pipe to be raised and lowered to suit the depth at which the work is progressing."

The defendant contends that the complainant was not the inventor of the machine thus patented to him, but that he copied its essential features from a machine built and invented by the defendant; and, moreover, that the complainant's machine was anticipated by various other patents and publications set up in the answer. If the evidence shows this to be true, we need go no further with the case. We therefore turn to the record to see what foundation, if any, there is for this contention. So far as the defense of anticipation is concerned, it must be established as of a date anterior to the patentee's invention or discovery; not merely prior to the application for, or the date of, his patent. Rev. St. §§ 4886, 4920; Plow Works v. Starling, 140 U. S. 198, 11 Sup. Ct. 803; Clark Thread Co. v. Willimantic Linen Co., 140 U. S. 492, 11 Sup. Ct. 846; Loom Co. v. Higgins, 105 U. S. 592; Kneeland v. Sheriff, 2 Fed. 901; Woodman v. Stimpson, 3 Fish. Pat. Cas. 105, Fed. Cas. No. 17,979; Merw. Pat. Inv. § 323. And, as against the defense of anticipation, it is well settled that the patentee may show, if he can, the fact of invention by drawings, sketches, models, or any other competent proof. Walk. Pat. § 70; Loom Co. v. Higgins, 105 U. S. 594; Bates v. Coe, 98 U. S. 34; Smith v. Vulcanite Co., 93 U. S. 486; Apparatus Co. v. Woerle, 29 Fed. 451.

The record shows that for many years the complainant was investigating the subject of dredging, and had familiarized himself with most, if not all, of the dredgers in existence. He was familiar, too, with the sand pump. The latter, while it would pump sand, would not cut and remove hard material. Before the complainant did anything in the direction of invention, there were also dredgers in existence and in use that would cut and remove hard material. There were the "Scoop" and the "Clam Shell," and the "Chain Bucket," and Hart's dredger, and Fraser's dredger, and the patent to D. S. Howard of January 9, 1855, and Atkinson's patent of July 7, 1863, and the

rotary-wheel dredge of Fondé and Lyons, and other rotary dredgers of which the complainant had knowledge; for in the original specification contained in his application for a patent he himself stated that "for more than two centuries rotary dredges have shown a capacity for cutting and lifting far in excess of any other dredging device; but in the forms of construction hitherto adopted it has been necessary to make the diameter of the wheel much greater than the depth to be dredged, thus making them too unwieldy for ordinary uses, while the best appliances for removing the spoils have fallen far short of the dredging capacity of the wheel." But, prior to the complainant coming into the field, there was no machine, by whatever name known, that would, by the simultaneous and continuous co-operation of its various elements, cut and remove hard material from a waterway, and itself transport the same to any desired distance and place. The complainant undertook to accomplish that thing. The accomplishment of the purpose necessarily involved the severing of the material in place, the lifting of it, and its transportation through some sort of conduit to the desired place of deposit.

The evidence shows that the complainant, having devoted much study and thought to the subject, embodied his ideas in a drawing, marked "Exhibit DD," and which was introduced in evidence. Upon its face, the drawing is dated July 13, 1864. Counsel for the appellant assert in argument that this date is false; that the drawing was actually made in the year 1884, and antedated 20 years. The ground of this contention on the part of the appellant is that the words "inward delivery," which appear upon Exhibit DD, do not appear in the complainant's proceedings in the patent office prior to March, 1884. The words "inward discharge" appear, instead, in the complainant's original specification. The two expressions mean one and the same thing. The use of the word "discharge" in place of the word "delivery," in the original specification, is explained by the complainant by saying that the first draft of the specification was prepared by his attorney, who used the term "inward discharge" instead of "inward delivery," and that, when he (the complainant) revised and redrafted the specification before sending it to the patent office, he followed the phraseology of his attorney, but that subsequently, when he took personal charge of his application, he redrafted the specification and claims and adopted the phraseology originally used by him in the drawings of 1864. There is nothing in the circumstance relied on by the appellant to cast any doubt upon the testimony of the complainant in respect to the true date of Exhibits DD and EE, especially as there is much testimony corroborative of that of the complainant, which is to the effect that he made the drawing on the day they, respectively, bear date.

The complainant testified that, while holding a position as clerk in the office of the United States surveyor general for the state of California, he was thrown in daily contact with all matters pertaining to swamp land and swamp land reclamation, and had many conversa-

tions with people desirous of reclaiming such lands, and in regard to the best mode of doing so.

"This led me," said the witness, "to continue my investigation of dredging and ditching machinery, and I soon came to the conclusion that the proper mode of leveeing a river was to take the material from the bed of the river. I then conducted a series of experiments with regard to the carrying capacity of water in pipes. I discovered that, by cutting holes in the bottom of the pipe, the sand would drop through those holes, while the water would pass over and be discharged where I wished to deposit the sand, and in this way I could build sand embankments. This led me to devise a hopper with an injection pipe entering the bottom of the hopper directly opposite to the mouth of a discharge pipe, and the material to be dumped into this hopper and carried by the injection stream through the discharge pipe. I then considered the mode of applying this method with reference to putting the material from the river on shore. This led me to connect with my pipe floats for supporting it. I then became convinced that centrifugal pumps would carry off a larger quantity of material than could be handled by ordinary dredgers, and I began to investigate for the purpose of discovering some method of supplying the pump with all the material that it could handle. This led to the combination with the aforesaid apparatus of a rotary excavator, and on the 13th day of July, 1864, I made a drawing showing this combination, which I now produce, and offer in evidence [being Exhibit DD]. The date above mentioned appears upon the drawing itself. I fix this date in three ways: First. Because I was so elated with the idea that I would never forget it if I would live to be a thousand years old. I thought I had discovered something that was going to make me a fortune. Second. Because of the date appearing on the drawing itself. Third. Because I was introduced the day before, by John S. Hittell, to the librarian of the Mercantile Library; and while there in that library, on the 12th day of July, I found in Cressley's Encyclopedia of Engineering an account of Bailey's rotary excavator used in the time of King Charles the Second of England; and that set me to thinking, and led me to devise the combination, which I thought out during the night, and of which I made a drawing the next day. This drawing represents a rotary excavator with inward delivery through itself to a suction pipe. These buckets are of themselves bottomless, and revolve around an inner cylinder, which forms a bottom to the buckets until they reach a depression in the top of said inner cylinder where the material is discharged into a receiver communicating with the suction pipe. Objection being made to this sketch by certain parties to whom I showed it, on the ground that material might wedge in between the buckets and the drum, I devised and made a drawing of the rotary bucket-wheel excavator, with hinged falling bottoms, to obviate this difficulty. This drawing last referred to was made the following day, July 14, 1864, and that drawing I now produce, and offer in evidence [being Complainant's Exhibit EE]."

This testimony of the complainant in respect to the time when the drawings Exhibits DD and EE were made finds corroboration in the testimony of the witnesses Houghton, McGann, Crane, Bender, Shaw, and Gray. We are satisfied from the evidence that they, together with the memoranda appearing upon them, were made at the time they respectively bear date. Copies of those drawings and memoranda are inserted on page 130. They show not only and altogether new combination of elements for the transportation of the spoils, but also something radically new in rotary excavators, namely, a rotary excavator with inward delivery through itself in combination with a suction pipe. They show a dredge boat having two self-con-

tained pivots or centers of oscillation for the swinging of the boat while at work; a flexible joint near the pivots; a discharge pipe consisting of an inner flexible oscillating section, a series of sections flexibly joined together, and supported by floats, and an outer rigid nonoscillating section; a suction pipe; a rotary excavator having inward delivery; the arc-shaped cuts of the excavator made by the dredge while swinging from side to side on the pivot; and devices for its working with a side feed. All of these are also shown in the complainant's patent 318,859. In 1868 the complainant made four models showing different forms of construction of his invention, marked "M²," "M," "N," and "II," respectively, and which were introduced in evidence, and are inserted on pages 126–129. While these models show details of construction not shown in the drawings upon Exhibits DD and EE (II, among other things, showing the inner cylinder at the end of the suction pipe partially cut away, and N showing it entirely removed, and N also showing the trunnions of claim 59 of patent 318,859), they each and all embody the principle of the invention represented by those drawings and the memoranda thereon. All of this antedated by many years the defendant's patent for his first dredger, as well as his plans and model therefor, which, according to the averments of his answer, were not made until the years 1874 and 1875, respectively. Hence it cannot be true that the complainant got his ideas from any model or machine of the defendant.

The complainant did not, however, make any application for a patent for his invention until December 9, 1876. But from the time of its conception he was indefatigable in his efforts to perfect it, and to demonstrate its practical utility. His long delay in applying for a patent, the appellant contends, constituted an abandonment of whatever invention was made by him. To review the many pages of evidence going to show the reasons for the delay in the complainant's application would serve no useful purpose. It is enough to say that, so far from showing any intentional abandonment on the part of the complainant, they show the most persistent and continuous efforts on his part, against very adverse circumstances, to perfect the invention, and avail himself of its benefits, and excuses the laches with which he might otherwise be justly charged. It was so held by the patent office, where the question of abandonment was raised, and was decided in favor of the complainant. "No general standard by which diligence can be established has been established by the law; nor, in the nature of things, is such a standard possible. It must be reasonable under all the circumstances of the particular case in question. The character of the invention; the health, the means, the liberty of the inventor; his occupation upon kindred or subordinate inventions, —are proper subjects for consideration. Such reasonable diligence does not involve uninterrupted effort, nor the concentration of his entire energies upon the single enterprise." Rob. Pat. § 387.

The original application of the complainant for a patent for his invention was filed in the patent office, as has been said, December

9, 1876. It embraced a description of his invention and claims, and was accompanied by a model. The original specifications and claims were prepared by the complainant's attorneys, and met with objections in the patent office. After amendments by the attorneys, the patent office allowed 20 of the 54 claims embraced in the application. The complainant refused to accept the claims as allowed, on the ground that they failed to properly cover his invention, and allowed his application to lapse by failing to pay the government fee within six months after the allowance; but within two years after that date, to wit, April 16, 1879, he filed a renewed application for letters patent for his said invention, asking therein that the original specification, oath, drawings, and model be used as a part thereof. Based upon the renewed application, the patent office demanded of the complainant's attorneys further description and illustration of the invention, which the attorneys insisted was unnecessary. Much correspondence ensued between the attorneys and the patent office upon that question, and finally the complainant concluded to take personal charge of his application, and accordingly addressed to the commissioner of patents the following communication:

"613 Mission St., San Francisco, June 13, 1882.

"To the Commissioner of Patents, Washington, D. C.—Sir: Unable to fee attorneys to prosecute my cases at the patent office, they hang fire, while I grow grey. It becomes necessary for me to do the best I can with them myself. The power of attorney heretofore granted by me to Dewey & Co., of San Francisco, and A. H. Evans, of Washington, D. C., is hereby revoked in the case of the renewal application for improvements of dredging machines. Ignorant of the changes that may have been made in specifications or drawings, I inclose $5 for copy of contents of the file wrapper. I cannot give the serial number.

"Respectfully, A. B. Bowers."

On the next day, June 14, 1882, the complainant sent to the patent office a communication amending his specification, "by striking out all thereof save the signatures, preparatory to submitting a new specification, in accordance with the views of the examiner"; and on July 26, 1882, he filed in the patent office the new and substituted specification. The examiner having found that the specification as thus amended included new matter not disclosed in the original application, the complainant struck out all of the amended specification except the signatures, and on November 13, 1882, filed a second new and substituted specification. Much correspondence thereupon ensued between the patent office and the complainant, resulting in the complainant going to Washington in person, and there, concluding that his invention could not be covered by a single patent, and that several patents would be necessary to properly cover it in all of its parts, determined to, and accordingly did, divide his application into several divisional applications. The first divisional application so filed by him culminated in patent numbered 318,859, issued May 26, 1885. His second divisional application was patented on the same day, May 26, 1885, by patent numbered 318,860, for "The Art of

Dredging." His third divisional application embraced all the remainder of his original application not comprised in the first and second divisions. This third divisional application was filed April 29, 1885, while the original application was pending, and before the issuance of any patent. In the prosecution of his third divisional application, it was found that several independent inventions were described, and that it, too, would have to be divided accordingly. The complainant divided it into nine different divisions, and filed divisional applications therefor, while the third divisional application was pending, and before the issuance of any patent therefor. The second of these last-mentioned divisional applications was filed August 3, 1886, and patented December 28, 1886, as No. 355,251, which is the second patent sued upon herein.

The defendant, on July 3, 1876, made application for a patent for an improvement in dredging machines, and for such improved dredging machine a patent was issued to him December 19, 1876, and is numbered 165,600. It is conceded by both parties to the present controversy that nothing covered by that patent to the defendant constitutes any infringement of the invention claimed by the complainant. Subsequently, the defendant applied for a patent for a new and improved excavating curved rotating plow for submarine work; and on May 8, 1883, a patent therefor was issued to him, and numbered 277,177. Two other patents were afterwards issued to the defendant,—one of date June 10, 1884, for a new and useful improvement in dredging machines, and the other of date October 7, 1884, for a new and useful improvement in rotary plows for submarine work. Under his patents the defendant built and operated two machines. The first machine so built and operated by the defendant was confessedly no infringement of anything patented to the complainant; and if, as is contended by the counsel for the appellant, the second machine built and operated by him, "with the exception of having a greater capacity and more power, was built just like" his first machine, it would follow necessarily that the second and only other dredging machine built or operated by the defendant within the state of California could no more be an infringement of anything patented to the complainant than was his first dredger. But is that assertion of the counsel for the appellant correct? The defendant's first machine was built in 1876, in accordance with his patent 165,600. The machine there patented, and as thus constructed, had no self-contained pivot, and, of course, no devices for swinging or for working the boat on such pivot; nor did it contain any floating or submerged discharge pipe. Its excavator, while rotary, consisted of radiating arms, the effect of which was the exact reverse of that of inward delivery. The defendant states in his patent for his second invention that it "has for its object to so construct the plow that, when connected with any suitable scow or float, and properly geared with any suitable driving mechanism, it may be readily rotated; and, with these ends in view, my invention consists of a rotary plow so curved on the land side that the rotary sweep of

the plow will be within the circle described from the axis of motion of the plow." And in his specification he proceeded to describe the construction and operation of the plow, referring by letters to the drawings accompanying the same, as follows:

"A represents a series of plows made in the ordinary manner, except that the land side, b, is curved in a line drawn from the axis of motion of the rotating ring support. These plows, A, are secured in position by vertical plates, B, and screw bolts, a, to circular frame or ring, D, formed with radial wrought-iron arms, C, and hub, H, the latter being secured by a feather or in any other suitable manner to a vertical hollow shaft, E, provided near its upper end with a bevel-gear meshing, with a similar gear on the end of a horizontal driving shaft, which may be driven by an engine on the scow or float. The vertical hollow shaft, E, is secured by any suitable means to bearings on the side of a vertical frame, which, in the instance illustrated in the drawings, consists of a hollow tube, J, the lower end of which is provided with a foot valve, K; and within this tubular frame may be arranged a suction dredging tube, I, the frame, J, and tube, I, being so arranged with reference to the ring frame, D, of the plows, that the material loosened by the plows will be dredged from the center.

"It will be observed that the land side, b, of the plows, being curved, causes the sand, mud, &c., loosened by the plows, to be swept to the center, where it can be readily acted upon by the dredge. L is a hood arranged over the plows and their supporting ring frame, D, to protect the same, and the plows are set at an angle, so as to cut slightly outside said hood. To the upper end of the hollow shaft, E, I connect, by a swivel coupling, F, a hose, G, which I employ to conduct a stream of water under pressure, should the plows, A, be caved in on; this stream of water, as will be readily understood, serving to break up and scatter the sand or mud where it acts as an impediment to the action of the plows. The channel cut by the plows will be in the direction of the movement of the float or scow, on the same principle as a metallic 'routing machine.'

"I do not, of course, wish to limit myself to all of the exact details of construction shown, as they may be varied in many particulars without departing from the spirit of my invention; as, for instance, while I have shown the supporting frame of the vertical shaft, E, as constituting a hollow tube, with an exhaust or suction dredge tube arranged within the same, for the purpose of removing the material plowed up by the plows, A, I may substitute therefor any suitable supporting frame, and employ any desired independent mechanism. I have shown the ring frame, D, armed with four plows, A; but I do not wish to be confined in this particular, as a greater or less number of plows may be employed, the gist of my invention resting in the idea of the rotary plows formed with a curved land side, and connected with a rotary frame, so that they may be rotated from a central driving shaft, and in combining with such arrangement a means for flushing and disintegrating the material cut up by the plows by means of a stream of water under high pressure."

The claims embraced in the defendant's patent 277,177 are as follows:

"(1) The plows, A, provided with land sides, b, curved to conform to the circle of their rotation, in combination with a rotary frame or ring, D, and driving shaft, E, substantially as and for the purpose set forth.

"(2) In combination with the plows, A, provided with curved land sides, as described, and the revolving frame or ring, D, the driving hollow shaft, E, and suitable hose and connections, G, F, substantially as and for the purpose set forth."

That the plows of this patent, unlike the excavator of the defendant's first patent, have an inward delivery through itself to a nonrotating suction pipe, is plain; and, indeed, it is, in effect, so declared by the defendant himself in his specification above quoted, for he says:

"It will be observed that the land side, b, of the plows, being curved, causes the sand, mud, &c., loosened by the plows, to be swept to the center, where it can be readily acted upon by the dredge."

These specific devices thus described by the defendant in his specification, and for which his patent 277,177 was issued, and which were afterwards embodied by him in his second machine, not being specifically described in either of the complainant's patents, it is urged on the part of the appellant that no infringement of those patents is thereby shown. If the complainant is to be limited to the specific devices described in his patents, that would undoubtedly be true; but, as has already been said, he was the first to invent not only a rotary excavator having an inward delivery through itself to a suction pipe, but also of the combination of such an excavator with transporting and discharging devices by means of which hard material in place can be severed, lifted, and continuously carried over water or land to any desired place of deposit. He is therefore justly entitled to be regarded as standing at the head of the art in those respects, and to a broad and liberal construction of his claims thereto. So regarding him, the objections of the appellant to the validity of the complainant's patents are not well taken. Those most urged are that the complainant's claims are merely for functions and results, and that they constitute aggregations only.

By section 4888 of the Revised Statutes it is provided that every inventor, when making his application for a patent, shall file in the patent office a written description of his invention; and, if the application be for a machine, he is required to explain the principle thereof, and the best mode in which he has contemplated applying the principle, so as to distinguish it from other inventions. But he is not necessarily limited to the one mode shown. The pioneer inventor is entitled to a generic claim, under which will be included every species included within the genus. In addition to such generic claim, he may include in the same application specific claims for one or more of the species. Machine Co. v. Lancaster, 129 U. S. 263, 9 Sup. Ct. 299; Clough v. Barker, 106 U. S. 166, 1 Sup. Ct. 188; Clough v. Manufacturing Co., 106 U. S. 178, 1 Sup. Ct. 198; Rob. Pat. § 535; Hammerschlag v. Scamoni, 7 Fed. 584; Telephone Co. v. Spencer, 8 Fed. 509; Machine Co. v. Teague, 15 Fed. 390; Manufacturing Co. v. Buffalo, 20 Fed. 126; Brush Electric Co. v. Electric Imp. Co., 52 Fed. 965; Ex parte Nagle (1870) Com. Dec. 137; Ex parte Howland, 12 O. G. 889.

When the complainant claimed, in claim 10 of his patent 318,859, "a dredge boat having a self-contained pivot, forming a center of horizontal oscillation, with devices for swinging and working

said boat upon said pivot, in combination with a suction pipe, exhausting apparatus, and rotary excavator," he was not claiming a result, which, of course, he could not do. Nor did he thereby limit himself to any particular form of construction of the several devices therein mentioned. What he there claimed, and what he, as the first inventor of any combination that would accomplish the desired result had a right to claim, was the combination of a dredge boat itself containing a pivot forming a center of horizontal oscillation, with devices for swinging and for working the boat on the pivot, a rotary excavator for the severing of the material in place, a suction pipe for its receipt and transmission to the exhausting apparatus, and the latter for the transportation and discharge of the spoils to the desired place of deposit. The record shows that the complainant was the first to combine those elements at all, and that the functions performed by his machine so constructed were entirely new. Hence he had the right to make the broad and generic claim embodied in claim 10, without any limitation as to the form of construction of the particular elements, and all subsequent machines which employ substantially the same means to accomplish the same result are infringements, notwithstanding the subsequent machine may contain improvements in separate mechanism which go to make up the machine. Authorities supra, and McCormick v. Talcott, 20 How. 402; Railway Co. v. Sayles, 97 U. S. 554; Clough v. Barker, 106 U. S. 166, 1 Sup. Ct. 188; Consolidated Safety-Valve Co. v. Crosby Steam Gauge & Valve Co., 113 U. S. 157, 5 Sup. Ct. 513. Of course, it remained open to any subsequent inventor to accomplish the same result by substantially different means.

Claim 16 of the complainant's patent 318,859 is a combination of a dredge boat, a floating pipe, a land pipe, and a flexible joint between them. The same combination was, for the first time in the history of the art, made by the complainant July 13, 1864, and illustrated by the drawings and memoranda upon Exhibit DD.

Claim 25 is for a combination of a discharge pipe, consisting of a series of sections flexibly joined together, floats for supporting the pipe on water, and a dredger having a rotary excavator.

Claim 53 is for a combination of a nonrotative suction pipe with a rotary excavator, having an inward delivery through itself.

Claim 54 added to the combination covered by claim 53 a dredge boat; and claim 59 added to the combination covered by claim 53 trunnions or equivalent joints to permit the excavator and outer ends of the suction pipe to be raised and lowered to suit the depth at which the work is progressing. The trunnions embraced by claim 59 are not shown in the complainant's drawings of 1864, but are shown in the model N made by him in 1868, and are thus described in his specification:

"The swinging portion of this [suction] pipe is mounted at the inner end of the well upon strong trunnions, one of which forms an elbow of the pipe, and passes through a stuffing box, or other suitable connection, into the suction

pipe of the pump B. Through the other trunnion passes a shaft that actuates the gears, i, that drives the shaft, R, and bucket wheel, E; and upon these trunnions the shaft, R, suction pipe, and excavator swing as the cutter is raised or lowered, to suit the depth at which the work is progressing."

Claims 13, 17, and 18 of the complainant's patent 355,251, found by the court below to have been infringed by the defendant, are as follows:

"(13) In combination, a dredge boat, exhausting device, telescoping suction pipe, and a rotary excavator provided with detachable cutting edges."

"(17) In combination, a dredge boat, exhausting device, telescoping suction pipe, and a swinging section of discharge pipe flexibly joined to the boat, and to an outer stationary section, to allow said boat to feed forward, and said oscillating pipe to swing on the joint connecting the oscillating and nonoscillating sections.

"(18) In combination, a dredge boat, exhausting device, telescoping suction pipe, rotary excavator, and a swinging section of discharge pipe flexibly joined to the boat, and to an outer stationary section, to allow said boat to feed forward, and said oscillating pipe to swing on the joint connecting said oscillating and nonoscillating sections."

The element here introduced that is not embraced by any claim of patent 318,859 is a telescoping suction pipe, which is thus described in the specification contained in patent 355,251:

"C is a suction pipe provided with an elbow and telescoping section or sections, C'. It is also provided with stiffening slide rods, t, t, t, that pass through suitable slides or guides at the top and bottom of the elbow, and at the lower end of each telescoping section, except the lowest, to the latter of which they are firmly secured by strong fastenings. These slide rods are large and strong, to keep the telescoping sections of pipe and the bearings of the excavator shaft in line, and insure their easy working. The joints of the telescoping sections are placed below the surface of the water, to obviate the necessity for stuffing boxes and packing. This pipe is also provided with a hollow (generally a rotary) excavator, that delivers its spoil inward through itself to said pipe. It is further provided that the chain, i, secured to the lower end of the lowest telescoping section, and passing over suitable sheaves to a hoisting device, by means of which it is raised and lowered in the process of dredging. Similar chains are attached to the lower ends of the intermediate telescoping pipes, and to some suitable point above, to prevent said intermediate pipes from dropping out of the pipes above them."

While the telescoping suction pipe was old, the record shows that the complainant was the first to combine it with the other elements of the several combinations specified in claims 13, 17, and 18 of patent 355,251. In no just or proper sense can any of the combinations described in the complainant's claims involved on this appeal be said to be mere aggregations, for the reason that the result is the product of the combination, each element affecting the action of the others, and all of them co-operating in the one result of severing by the forward and side action of the machine the material in place where it is not wanted, and depositing it in another place where it is wanted. The flexible joints of the floating discharge pipe and the vertical anchors or turntable, as the case may be, permit the movement of the machine from side to side, as well as forward, and, in combination with the other elements spec-