When the parts of the pulley are united, the rim segments are in contact at their meeting ends, while the two sections of the divided spoke bars are united at their ends, but separated between the rims by an open space, extending from rim to rim. A shaft hole is provided in the spoke bars at the center of the pulley, one-half in each section; and, when the two parts are placed upon the shaft, the clamp bolts (which are near the hub, and on each side thereof) are tightened to bind the hub to the shaft. The open space between the parts of the spoke prevents any interference with the tightening of the clamp bolts, or the binding effect of the entire inner surface of the thimble or bushing of the hub upon the shaft. The specification states (preliminary to the descriptive part thereof) that the pulleys are to be made of wood. This statement must be considered as running through the entire specification and claims, saving two stated exceptions: (1) That the construction referred to in the first claim is equally applicable to wooden and metallic pulleys; and (2) that the wood thimbles referred to in the third claim are equally applicable to metallic or wooden separable pulleys. There is no statement anywhere that the thimbles or bushings may be made of any substance other than wood; and hence the broad statement first above referred to applies to them without qualification. For the purpose for which thimbles or bushings are employed, metal is not the mechanical equivalent of wood, because—First, being a yielding material, wood adapts itself to the irregular surface of the shaft, while metal does not; second, its adhesive or tractional power, as compared with metal, is as from 90 to 100 to 41, according to the kind of wood used, hard maple being the best; and, third, it is lighter, cheaper, and more convenient to manufacture and handle. It appears from the evidence that metal shafting is quite irregular in its contour, and the thimble, to make it fit, must be made of compressible material. Complainants have never used any material for the thimbles except wood, and the invention of their patent relates to wooden thimbles. Bushings of paper, leather, or cloth, wound round the shaft, are not the equivalents of the complainants' wooden bushings, nor are bushings of metal, unless the surface of the metal be so serrated or roughened as to yield and adjust itself to the irregularities of the shaft when under compression. Hence, in order to anticipate the third claim, there must be shown an anticipating device having its rim segments in contact, a divided spoke united at the ends, but separated between the rims of the pulley by an open space, and a hub provided with a split bushing of wood or its equivalent, and adapted to be clamped to its shaft by compression.

The defendants set up and have introduced evidence tending to prove 29 instances of prior use. The complainants' testimony and exhibits in chief cover 64 printed pages, the defendants' 1350 pages, and the complainants' in rebuttal 1979 pages; being in all 3393 pages, not including patents and illustrations, covering 400 or 500 pages in addition. This testimony is, in the main, pertinent

to the case. It is full of evidence relating to disputed and hotly-contested questions of fact, but its great bulk renders it impracticable to enter largely into details, and compels the court to limit its opinion almost entirely to statements of general conclusions.

The defense is want of patentable novelty in claims 1 and 3, and that they are wholly void, in view of the prior state of the art, as exhibited both by prior patents and publications, and by numerous prior public uses and sales, more than two years before the date of the application for the patent in suit. Ten patents and two publications are set up and introduced in evidence as anticipations. Defendants' expert testifies that wooden pulleys have been quite common, although pulleys are most frequently made of cast iron accurately bored to fit the shaft, and secured to it by set screws, put through the hub, and forced against the shaft, so as to pinch it with their points. Such pulleys can be shifted along the shaft (which must be put up accurately in line), between the hangers; but, if they are to be transposed or shifted beyond the hanger, the shaft must be disconnected or taken down, so that the pulleys may be stripped off to make the desired change. It is necessary also to disconnect the journal boxes of the hangers. Accordingly, journal boxes in two halves have been long in use, to avoid the necessity of taking down the hangers or stripping off the boxes. Bushes or linings to save the box from wear are also old. There have been split pulleys, and it is testified that the idea of pulley halves in contact only at the rim, and open elsewhere, so that the clamp bolts may draw the hub tightly to the shaft, is old; but examination of the patents and publications relied upon in support of this contention shows that none of them contain the combination or produce the results of the invention, discovered by the complainants' patent. Take, for illustration, the patent of Schellkopf (No. 168,925), of 1876, which is referred to by defendants' expert as most closely approximating the structure of the patent in suit. That shows a wooden pulley in halves, the meeting ends of the rim not in contact; a solid iron center, not split or divided; no bushing; and the hub not held on the shaft by compression. None of the prior patents or publications anticipate the complainants' patent.

The testimony as to prior uses is to be considered with reference to the rules of law applicable. It is a fundamental principle of the patent law that, to invalidate a patent by prior invention or use, the proof must establish the fact beyond reasonable doubt. "The burden of proof rests upon him [the defendant], and every reasonable doubt should be resolved against him." Coffin v. Ogden, 18 Wall. 120, 124; Cantrell v. Wallick, 117 U. S. 689, 696, 6 Sup. Ct. 970; The Barbed-Wire Patent, 143 U. S. 275, 285, 12 Sup. Ct. 443, 450.

This means that "this defense must be established by proof as explicit and convincing as that required to convict a person charged with crime." Cluett v. Claflin, 30 Fed. 921, 922 (Coxe, J.); Ross v. Railway Co., 45 Fed. 424, 425 (Knowles, J.); Lalance & Grojean Manuf'g Co. v. Habermann Manuf'g Co., 53 Fed. 375, 378.

A fair doubt as to its reliability is always sufficient to dispose of testimony of this character. Mack v. Manufacturing Co., 52 Fed. 819, 821.

The inherent improbability of the story is sufficient to negative the testimony of any number of witnesses. The Telephone Cases, 126 U. S. 1, 2, 8 Sup. Ct. 778.

It is hardly necessary to say that each defense must be considered independently of all the others, and, so considered, must fail, unless it be established by proof beyond a reasonable doubt.

Four alleged prior uses are located at New Orleans,—the first, of split wood pulleys, at the Leed's Foundry, in 1876. But the spoke bars of those pulleys were straight and flush with the ends of the rim segments. The paper or leather which was wrapped about the shaft to prevent the slipping of the pulleys was not the equivalent of complainants' bushings. The split iron pulleys testified to had their halves in contact both at the rim and hub. There were other deficiencies, but these are sufficient to show that this prior use falls short of anticipation. As to the second use, Ex-Mayor Shakespeare, of New Orleans, who was examined for defendants, testified on cross-examination that the bushings were used to fill up the difference between the size of the shaft and the size of the hole in the pulley, so as to properly center the pulley on the shaft; that set screws or keys were depended upon to keep the pulley from slipping; that, if in any case there was a space left between the two parts of the hub or rim, it was caused by sawing or splitting apart the pulleys, when in contact by reason of having been made with half patterns, and accidental; and that he never knew of an iron pulley, whole or split, to be fitted on a shaft for actual service by clamping alone, but they depended on the key or set screw to hold the pulley in place. The third alleged prior use was by Sylvanus Noyes, in 1857. Upon cross-examination it appeared that the bushings to which he referred in his testimony in chief were mere centering rings, not intended or used for compression, but used in connection with keys or set screws; and that prior to 1884 he never knew of bushings being used for any other purpose in split iron or split wooden pulleys. It was also developed in his cross-examination that defendant's model put in evidence to illustrate this prior use was false and misleading; that its wood bushings were obtained in 1884, from an agent, for the sale of pulleys infringing complainants' patent. It further appeared that the so-called "bushings" in the pulley made and used in 1857 were large pieces of oak fastened to the arms of the pulley, to serve as its hub. The fourth alleged prior use at New Orleans was by William L. Cushing, prior to 1880, and relating to bushings. It turned out that they were not bushings at all, but brass journal bearings, for use in sugar mills; and the witnesses returned to the witness stand, and, explaining how the mistake occurred, retracted their former statements. Next comes the Sibley & Ware use, at South Bend, Ind., as early as 1876, of split iron pulleys, with split iron bushings. The pulley produced is in contact both at rim and hub, and the bushing is of iron, without any provision for it to be

conformed to the inequalities of the shaft; and therefore it is not the mechanical equivalent of complainants' bushing. Moreover, it appears that there was no bushing in the pulley prior to 1884, and that the bushing which is in the exhibit was made and put in to adapt the pulley to th shaft after a fire which had damaged the machinery, and made it necessary to put in a new shaft, which was smaller than the old one. An examination proved that the bore of the pulley was the size to fit the old shaft, and the bore of the bushing of the size to fit the new and smaller shaft, and it was shown by testimony that there was no bushing prior to the fire, which occurred in January, 1884, 18 months after the date of complainants' patent.

The evidence of defendants' witnesses with reference to the Strayer shop split wooden pulley is confused and contradictory, both in reference to dates and to the exhibit, which is a split-wood pulley, not bushed; and there is testimony that it has been tampered with and altered at some comparatively recent period.

The testimony for defendants relating to the "Curry, 1869, pulley," referred to in the brief for complainants as the "Orwell defense," is quite as unsatisfactory. The evidence of the four witnesses for defendants is contradicted and overcome by that of nine witnesses examined by complainants, corroborated by the original shaft itself, with the shingle machine pulley hub still remaining upon it. The next alleged prior use rests upon defendants' exhibit, Coher & Smith's wooden pulleys Nos. 1, 2, and 3, and their use in flouring mills at Niles, Mich., in 1877 and 1888. Here, too, the witnesses called in support of the defense are in conflict. They are contradicted by the split wood bushing of pulley No. 2, which shows on inspection that it has never been used in a flour mill, nor clamped on a shaft for actual service, for there is no mill dust in the open pores at its ends, but there is on its concave surfaces, which, in use, must have been tightly clamped upon the shaft, thus absolutely preventing the access of dust. Moreover, the bushing is bored on an incline, so that, if used, the pulley would not be perpendicular or at right angles to the shaft, but upon an incline, and wabble, so as to be practically incapable of carrying a belt. Still more, the concave surface of the bushing shows that it has never been subjected to compression, and the two halves of it do not match at their edges. Half a dozen witnesses for complainants testify that no such pulleys as are described by witnesses for defendants, or as are shown by the exhibit, were used in those mills until after the date of complainants' patent. In the Fulton defense (defendants' exhibit, Nelson Genesee Mills, at Fulton) the integrity of the witnesses called for defendants is not questioned, but that they were altogether wrong in antedating complainants' patent was so conclusively shown as to entirely dispose of the defense. In the Aurora defense (defendants' exhibit, Stedman & Co. invoice, 1873) the pulleys and the bushings were iron, and the pulleys were screwed to their shafts by set screws or keys. Split pulleys were never made, except on special order, and then to fit the shaft, and bushings were used only to fill up the

space when the shaft was not large enough to fit; in other words, were used only as centering rings. In the Louisville defense the pulleys and bushings were iron. It did not appear that the pulleys were clamped upon their shaft, nor that their rims were in contact, and hubs apart, nor that the bushings were used for any other purpose than centering rings.

The Mishawaka defenses,—that is to say, the furniture company, the Woolen, and the Bostwick,—the Allegheny defense, the Columbus, the Fairbank, the Cresson, the Sellers, the Centennial, and the Harrington defenses, are not dwelt upon in the brief for the defendants, and they may be passed with the general finding that no one of them is sustained. This brings us to the only remaining defenses, the Taper Sleeve pulley, or Erie, and the Saginaw, which are those upon which defendants place their main reliance, and are argued at length in their brief.

The defendants claim that it is proven "beyond the shadow of a doubt" that, continuously from 1877 to the present time, wooden split pulleys were made at the Taper Sleeve Pulley Works, Erie, Pa., to be clamped upon shafts, some of them by compression alone; and that the predecessor of the company operating said works had made solid wooden pulleys, held upon their shafts by compression alone, without the use of keys or set screws, from 1874 to 1877, that pulley being generally known as the "Taper Sleeve Pulley." Furthermore, it is claimed that this same concern at Erie made and sold, as early as 1879, metal split bushings, so that their pulleys might be transferred from shafts of larger to those of smaller diameter.

The testimony with reference to this use is too voluminous to be considered in detail. Defendants' exhibit "Erie Split Pulley Cut" shows that the pulleys prior to 1881 were made in two solid semicircular halves, without arms or spokes, and with their meeting edges perfectly straight. It appears from testimony of defendants' witnesses that cast-iron flanges were bolted to them at their center; that other bolts, extending from flange to flange, were provided for fastening the two halves together when on the shaft; that dowel pins along the meeting edges kept the two halves in line with each other; that the pulley halves, held slightly apart, were bored with an augur the size of the shaft; that they would not come together on the shaft, but there would be an open space about an eighth of an inch wide between them throughout their entire diameter; that links were applied near the rim to prevent the two halves from flying asunder; that the pulleys were fastened to their shafts by compression alone; that they were originally intended to be fastened by compression, but a good many customers had no faith in it, and insisted upon set screws. Two of defendants' witnesses were silent about set screws. Until about 1884 or 1885 these pulleys were all made in the form of web pulleys, instead of with spoke bars, but since then they have been made with arms. From complainants' evidence it appears that it was the custom to use compression and set screws in combina-

tion; that in 1879 it was the custom to send out split pulleys without set screws; and that the center flanges were always provided with set screws before they were used in pulleys. One witness testifies that from November or December, 1879, the split pulleys were all fastened with set screws; another, that from the spring of 1878 to May or June, 1882, they were all made with set screws; and still another, that the same was true as to all pulleys made from April, 1875, to the fall of 1880; and again another, that they were made with set screws, and their absence from a pulley indicated that it was not made there. The testimony for complainants is strongly fortified by the admitted fact that the pulleys were made with straight meeting edges, so that, if bored to the exact size of the shaft, their halves would be in contact, and no effective compression could take place. If bored smaller than the shaft, or when slightly separated from each other, their halves would not be in contact, either at rim or hub; and, even if compressed equally on each side of the shaft, they would not infringe complainants' patent, because the rims would still be separated. If compressed unequally,—that is, brought nearer together on one side than on the other,—the rims on one side of the pulley might be in contact, but the rims on the other side would be correspondingly separated; and the result would be neither an infringement of complainants' patent nor an operative pulley. In short, the complainants' patented pulley is the only one shown in the record in which compression to the shaft to any required degree—a compression bringing the entire inner surface of the hub to bear upon the shaft, and so constructed that it may be increased whenever necessary by reason of change of shaft, or of wear, or of any other cause—is so effected as to be superior to any other mode or means of fastening or attachment, and to impart to the pulley its greatest mechanical power, and yet leave it entirely separable into its own halves and from the shaft. To accomplish this result, there must be compression at the shaft, and contact at the rim, and the inner side of the divided spoke arm must be separated from rim to rim. Under such structural conditions, compression at the hub tightens the clamp upon the shaft, and at the same time makes firmer the contact at the rim; and the result is a union of pulley and shaft as nearly perfect as it can be made, the separated spoke bars acting in response to the action of the clamping bolts, not only without straining the pulley at any point, but actually making it firmer and stronger and more durable. There are in evidence book entries relating to orders for bushings for the Erie pulleys, in a paragraph separate from that containing the order for pulleys, and an entry showing that they were charged on the ledger, whereas the ledger contains no such charges. In order No. 466, dated June 17, 1889, the order for bushings is below the order for pulleys, and in newer ink, of a different color. In the other three orders, Nos. 475, 486, 492, the orders for pulleys are in ink, and the orders for bushings in pencil, and in each case the penciling has been rubbed, not by way of erasing, but so as to

give rise to the suspicion that an effort has been made to destroy its freshness, and make it look old. It is only necessary to say that these indications, and the recurrence of indications at different times and places, that pulleys put in evidence as exhibits of anticipating devices had been at some time and by somebody tampered with and altered, tend greatly to weaken the case for the defendants, and to emphasize the necessity and the importance of the rule that every reasonable doubt must be resolved against him who sets up the defense of prior invention or use. What is here said is not intended to reflect in the least upon defendants' counsel. Anything of that sort is expressly disclaimed by counsel for complainants, and, in the opinion of the court, would be incredible, by reason of their known integrity and high character. There is nothing to warrant the inference that it was stimulated by defendants themselves. The only motives suggested are (1) the unconscionable zeal of representatives of the defendants in connection with the preparation of the defense, and (2) the interest of witnesses who it is hinted may be held liable if complainants' patent is sustained. Two pulleys, with bushings, furnished to C. G. Hampton in August, 1879, are also referred to in the evidence. These also were straight edged, and, for reasons already stated, do not anticipate. There are other considerations touching these pulleys which might be dwelt upon, but it is unnecessary.

Lastly, we have what are called the "Saginaw Defenses." Of these, the first is the use at Edward Germain's Mill, at East Saginaw. This pulley, which is called the "Cowles Pulley," had its meeting edges straight and in contact. It was made solid, and sawed in two. It does not anticipate. The next is the Feige pulley. It was made with a tapering shaft hole, and could not be practically used on commercial shafting. When on a shaft of the specified size, the rims do not come together. The testimony as to dates is uncertain and unsatisfactory. This pulley cannot be recognized as an anticipation. The Gould pulley has its halves in contact throughout their entire diameter, excepting only when the bushing keeps them apart. The testimony as to the Shaw & William pulley is much of it uncertain, but, taken at its best, it shows that its meeting edges were intended to be parallel, and hence would be entirely—rim and hubs—in contact, or entirely out of contact, and not an anticipation of complainants' pulley. Mayflower pulleys No. 1 and No. 2 do not anticipate, because the hubs and rims of No. 1 are either wholly in contact or wholly out of contact, and No. 2 is not a split pulley, and does not have its hubs separated when on the shaft. These pulleys complete the list. Taken singly or all together, they do not impair, much less do they destroy, the validity of complainants' patent. Strongly corroborative of this view are the facts brought out in complainants' evidence concerning the introduction of their pulley at the New Orleans Exposition, and the subsequent demand for it, both in this country and abroad. Mr. Wallace H. Dodge, one of the inventors, took two car loads of pulleys to the New Orleans Exposition, in the winter of 1884. He obtained a permit from the exposition authori-

ties to sell pulleys to exhibitors, but in the first two weeks was able to place hardly a single pulley, because the authorities were afraid they would slip on the shaft, and annoy exhibitors. The official in charge of the shafting refused positively to allow any of the complainants' pulleys to be placed on the line shafting, but intimated that if Mr. Dodge could induce exhibitors to use them on counter shafts which they had to run, and they proved successful, he might allow him to put some on the line shafts. He made unsuccessful efforts to induce exhibitors to use the pulleys, but nearly every one said he did not like to experiment with the bushing system. William L. Cushing, who testified for the defendants in this cause, was one of the exhibitors who refused to buy or use, because he had no faith in the pulleys, and could not afford the risk of delay and annoyance, but finally, through the influence of his own superintendent, was induced to try them. After many delays and rebuffs, Dodge at last succeeded in persuading an exhibitor, who could not successfully operate his machinery with an iron pulley, to try one of his wooden pulleys, and it drove the machine—a planer—with perfect success. Then the pulley was applied successfully to shafting for running some dynamo machinery. After that there was no trouble in introducing it anywhere in the exposition, and nearly two car loads of pulleys were sold, and a New Orleans agency was established. In 1881 a few pulleys were sold for trial; in 1882 about 1,000 were sold; in 1883 about 2,500. The demand has steadily increased, so that in 1893 the number sold was over 200,000. The capacity of complainants' works in 1894 was about 1,000 pulleys per day. They have a manufacturing plant at Toronto, Can., where they employ from 75 to 100 men. They have an agency at Paris, France, and in most of the large cities in England, Germany, Switzerland, Russia, —in fact all the countries of Europe, also in Mexico; and in Australia they have large sales. Their English trade amounted in 1894 (the date of the testimony) to from five to eight thousand dollars per month.

The distrust and disfavor encountered and signally overcome at the New Orleans Exposition, where were congregated skilled operators of all kinds of machinery from a great number of localities, far and near; the phenomenal growth and widely extended success of complainants' manufacture; and the constantly increasing sales of their patented pulleys,—are facts which testify powerfully, not only to their value, but also to their novelty. The attempt to explain this away, by referring the extraordinary demand to the sudden and contemporaneous growth of the specialty manufacturing business, will hardly do, for the Taper Sleeve Pulley Company, at Erie, was in the pulley manufacturing business from 1877, and its predecessor from 1874; so that the business of manufacturing pulleys did not spring up about the time of or after complainants' invention, but had been carried on many years before then. The evidence is clear that defendants are infringers. The decree will be against them, with costs.

MAST, FOOS & CO. et al. v. IOWA WINDMILL & PUMP CO.

(Circuit Court of Appeals, Eighth Circuit. October 5, 1896.)

No. 689.

1. PATENTS—VALIDITY OF REISSUE—ENLARGEMENT OF CLAIMS—LACHES.
A delay of nearly three years in applying for a reissue enlarging the claims of a patent renders such reissue void, where in the meantime a new device has come into use, which was not covered by the original claims, but which is brought within the claims of the reissue. 68 Fed. 213, affirmed.

2. SAME.
The Bean reissue, No. 8,631 (original No. 175,588), for an improvement in pumps, is void because of laches in applying for the reissue, which enlarged the claims so as to include a subsequent construction. 68 Fed. 213, affirmed.

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

This suit was brought by Mast, Foos & Co. and William D. Hooker, the appellants, against the Iowa Windmill & Pump Company, the appellee, to restrain the infringement of claims 1, 2, 3, and 4 of patent No. 8,631, reissued to Roscoe Bean under date of March 25, 1879, the original patent being No. 175,588, dated April 4, 1876; also to restrain the infringement of certain claims of patents No. 339,445 and No. 259,394, which patents were issued, respectively, to Samuel W. Martin under date of April 6, 1886, and to William D. Hooker under date of June 13, 1882. Defenses were interposed by the defendant below to the entire bill. The circuit court sustained the charge of infringement so far as it related to the two patents, Nos. 339,445 and 259,394, issued to Samuel W. Martin and to William D. Hooker, and granted the relief prayed for as to those patents. It held, however, that the first, second, third, and fourth claims of reissued letters patent No. 8,631, granted to Roscoe Bean on March 25, 1879, were void. It accordingly dismissed the bill in so far as it was founded upon the claims of that patent. 68 Fed. 213. The complainants below have appealed from that part of the decree holding certain claims of the reissued patent to be void. The controversy therefore relates wholly to the validity of the first four claims of the reissued patent. The following are copies of the specifications of the original patent, No. 175,588, issued to Roscoe Bean on April 4, 1876, and of the reissued letters patent founded thereon, dated March 25, 1879. For convenient comparison, the specifications have been placed in opposite columns; and, for the purpose of more clearly indicating certain changes that were made in the original specification, some parts of the specifications are printed in italics:

Original.	Reissue.
The nature of my invention consists in the construction and novel arrangement of a pump stock, connected with the cylinder by two tubes, one forming an air chamber and the other the discharge pipe; *said tubes opening into the cylinder directly opposite each other*, as will be hereinafter more fully set forth.	The nature of my invention relates to force pumps, and it consists in a tubular air chamber attached to the pump stock or platform flange, and connecting to and opening into the cylinder *or chamber, and forming also a support for the same.* My invention further consists in a supporting tubular air chamber and discharge pipe attached to the pump stock or flange plate, and connecting with and opening into a cylinder *or chamber;* also, in the combination of parts as will be hereinafter more fully set forth and pointed out in the claims.