packing: 72 establishments, with $8,464,000 capital, employ 12,891 persons, and put up $81,570,000 in value of meats. The iron and steel manufactures reach about $25,000,000. The rolling mill products are valued at $15,673,624, not including the Bessemer Steel Works, the values for which are merged in a general item. The manufacture of clothing foots up $17,423,607; sash, doors, etc., $8,981,281; bridges and railroad stock, $8,030,398; furniture, $7,188,278; tanning and currying, $5,637,000; alcohol and rectifying, $5,024,220; lard oil, $6,508,800.

DECISIONS RELATING TO PATENTS.

United States Circuit Court—District of Vermont.

HOLLY *vs.* VERGENNES MACHINE COMPANY.

Wheeler, J.:

1. The meaning of the claims in a patent is to be derived from the specification.

2. Two devices are substantially the same in the sense of the law of patents when they perform the same functions in substantially the same way to accomplish the same result, and, except when form is of the essence of the invention, it should not be regarded in the question of infringement.

3. In determining the matter of infringement attention should be paid to such portions as really do the work, so as not to give undue importance to parts used only as a convenient mode of construction.

4. The patentee is entitled to the exclusive use of the whole of his patented invention, and if it is of a combination of numerous parts, including in it other new and useful combinations of less of the parts, he seems to be entitled to the exclusive use of these lesser combinations, as well as to the exclusive use of the whole.

This suit is brought upon reissued letters patent, No. 5,132, dated November 5, 1872, for a new system of waterworks for supplying cities and towns with water, and original letters patent, No. 94,747, dated September 14, 1869, for a new safety valve for street water pipes, both granted to the plaintiff. The defenses are that the plaintiff is not the original and first inventor of the inventions described in the patents, and that the defendants do not infringe. The cause was heard at last term on pleadings, proofs, and arguments of counsel.

Before the plaintiff's invention water to supply cities and towns was, when the supply was located high enough, drawn into a reservoir, and from thence into a main pipe, from which others ramified through all parts of the city or town and into dwellings and other places to spigots, from which it could be drawn as wanted for use. In level places, where there was still an elevation for a reservoir, it was forced by pumps into a reservoir, and when there was no such elevation it was forced into a stand-pipe of the necessary size and height or into mains connecting with such a stand pipe, and the pressure of the water in the reservoirs or stand-pipes would regulate the flow to the spigots and hydrants. Where it had to be supplied by pumps the irregularity in the amount drawn at the spigots and hydrants would not admit of a uniform supply to the mains, and if pumps were employed for furnishing such a supply the incompressibility of water is such that when the drawing ceased the pipes would burst or the pumps or machinery be broken.

The plaintiff's inventions obviated these difficulties by providing pumping machinery which increasing pressure of water in the mains would slacken and decreasing pressure would hasten, and guarding against sudden shocks from the quick closing of hydrants by the use of an air chamber connecting with the mains, and preventing the danger of continued pressure from that source while the machinery was slackening by a peculiarly arranged relief valve applied to the mains, so that the water could be pumped directly into the mains and drawn therefrom by the spigots and hydrants at pleasure with safety to the works without any stand-pipe or reservoir. None of the systems set up as anticipations had these contrivances combined in this manner.

The London waterworks, constructed by Peter Maurice in 1582, as described by Thomas Ewbank in "Hydraulics and Mechanics;" the system of waterworks described in the English patent to Joseph Bramah, dated October 31, 1812; and the London bridge waterworks, described by William Mathews in "Hydraulia, 1835," had pumps forcing water directly into mains to be carried to inhabitants; but neither of them had any contrivances for slackening the quantity forced as any pressure increased from diminishing the quantity drawn, as described; neither does it appear from the descriptions given but that the water flowed through by a constant flow, and was caught as wanted for use. Birkinbine's system at the State Lunatic Hospital at Harrisburg, Pennsylvania, had connection with a reservoir at the top of the building. Linsley's system at Burlington, Vermont, had connection with a reservoir above the city. Birkinbine had no means for regulating the quantity pumped by the severity of the pressure in the mains, and Linsley had none for lessening the quantity as the pressure increased. His system was nearer like the plaintiff's than any other was, but his lacked some of the essential features of the plaintiff's. His had means for slackening the pumping machinery when the pressure in the mains decreased, to prevent the machinery from running away if the pressure should be removed by bursting or other casualty; but this is quite different from regulating the supply according to the pressure. He had pipes leading each way from the main carrying the water up to the reservoir, and as to those pipes the water was pumped directly into them without going to the reservoir; but as they were connected by the main with the reservoir the pressure in them would be regulated by the pressure from the reservoir, and would not in any manner regulate the quantity pumped according to their requirements. Birkinbine had a safety valve on the main for the same purposes as the plaintiff's relief valve; but his valve was held by dead weights, while the plaintiff's is steadied by a dash pot. None of these things show that the plaintiff was not the original and first inventor of the inventions described in both patents.

This is in accordance with the decision of Drummond and Gresham, J. J., in *Holly vs. Union City* (14 O. G., 5), so far as that decision goes, which only involves the reissued patent. This suit rests upon the first claim to that patent, which is for—

"The above-described method of supplying a city with water—that is to say, by pumping directly into the water mains when the apparatus for that purpose is supplied with contrivances by which the pressure within those mains may be preserved in a great degree uniform, sufficiently so for practical purposes, or increased or diminished at pleasure, substantially as and for the purpose above shown."

It is objected that this claim does not specify any devices constituting the system mentioned, and that it is too indefinite to furnish a foundation for a claim for infringement; but this objection cannot prevail. The patent is to be read altogether for the purpose of ascertaining the meaning of the whole and of every part. Consequently the specification may be referred to for ascertaining the meaning of the claims. (*Bates vs. Coe*, 15 O. G., 337; *Brooks vs. Fish*, 15 Haw., 215.)

The specification describes pumping apparatus which the increase of pressure in the mains will slacken and decrease will hasten. It describes mains connected with an air chamber and a relief valve for easing the shock of sudden and continued pressure, and mains from which the water is drawn as wanted, or closed mains, operating by pumping the water directly into the mains without a reservoir or stand-pipe. The claim of the system as and for the purposes above shown is a claim for this combination of these various contrivances, operating together in this manner for this purpose. It is for these devices so combined and arranged, and not for any abstract principle or method apart from the devices themselves. The claim appears to be valid when so construed. (*Holly vs. Union City*, 14 O. G., 5.)

The plaintiff's pumping apparatus is arranged so that the increase of pressure in the mains will lessen the amount of water being pumped into them by forcing the water against a piston, the motion of which, operating through complicated devices, shuts off the motive power and slackens the pumps. This is the pumping apparatus supplied with contrivances by which the pressure within the mains may be preserved in a great degree uniform which is mentioned in this first claim, and that part of the patented invention covered by this claim is the combination of this apparatus with the mains, the air chamber, the relief valve, the pipes, and the spigots.

The answer and the evidence show that the defendants have put in waterworks for cities and towns, or participated in putting them in, which have the pumping apparatus described in letters patent No. 154,468, dated August 25, 1864, issued to John P. Flanders, one of the defendants, for an improvement in pumps, stated in the specification to relate more particularly to pumping engines adapted to the delivery of large volumes of water, as in town or city supply where no stand-pipe or reservoir is employed, and in the description referring only to such engines as pump directly into the mains. In this pumping apparatus the increasing pressure of the water in the mains decreases the amount of water pumped in by acting upon a valve, which opens and closes a duct leading from one end of the pump cylinder to the other around past the piston, so that when the pressure opens the valve the water is pumped from one side of the piston to the other and not forced along, and when the pressure is diminished by the opening of the spigots and drawing water the valve closes and the water is forced along again to take the place of that drawn off. This is a pumping apparatus supplied with contrivances by which the pressure within the mains may be preserved in a great degree uniform, as mentioned in this claim of this original patent of the plaintiff. The combination and arrangement are the same in defendants' works as in the plaintiff's, unless there is a substantial difference in these pumping engines, and the rest of the combination is the same, whether there is a difference here or not.

Two questions arise here: One is whether these pumping engines are substantially the same in this arrangement, and the other is whether the rest of the arrangement is a part of the plaintiff's patented invention if they are not. If they are, the defendants have taken the whole of the invention covered by this claim. If they are not, and the rest of the combination without them is covered by the patent, then the defendants have taken so much of the patented invention. In this matter of regulating the flow of water in such pipes according to the wants of consumers, without the aid of the force of gravitation furnished by reservoirs and stand-pipes, the plaintiff precedes Flanders and has produced something which underlies all that Flanders has produced, and if it includes what Flanders has produced, he has a monopoly of it. (*Railway Co. vs. Sayles*, 97 U. S., 554.) And these pumping machines are substantially the same in the sense of the law of patents when they perform the same function in substantially the same way to accomplish the same result, and except where form is of the essence of the invention it should not be regarded in questions of this kind, and it is not of the essence of this invention. Attention should be paid to such portions as really do the work, so as not to give undue importance to parts used only as a convenient mode of construction. (*Machine Co. vs. Murphy*, 97 U. S., 120.)

Here the pressure in the mains does the work of lessening the flow. In the plaintiff's machine it does it by pressing against a valve and slackening the machinery propelling the water. In the defendants' machine it does it by pressing against a valve and lessening the effect of the machinery upon the water. The means are the same, the result the same, and the mode is different only in form. (*Foster vs. Moore*, 1 Curtis' C. C., 279.) If this was not so, the arrangement of the mains, air chamber, relief valve, and pipes was new, and a material part of the invention, which would be covered and included in this claim of the patent, and which the defendants would have no right to take and use in connection with Flanders' invention. (*Sellers vs. Dickinson*, 6 E. L. and Eq., 544, 5 Exch., 312; *Lister vs. Leather*, 8 Ell. and Backb., 1,004.)

Flanders' pumping apparatus is the equivalent of the plaintiff's in making up a system of waterworks with these other parts, although it may not be the same thing for other purposes. The question now is not whether they are the equivalents of each other for all purposes, but is whether they are for this purpose.

In *Sellers vs. Dickinson* the patent was for machinery, consisting, among other things, of a clutch box operating automatically to cut off the power from a loom whenever the shuttle became entangled, combined with other mechanical contrivances through which the momentum of the sley was made to move a brake against the flywheel to take up the momentum of the parts and prevent sudden shock from the stoppage. The clutch box was old, but its combination with the brake was new. The defendant's contrivance for accomplishing the same object, and for which he had obtained a patent, dispensed with a clutch box and had different contrivances from the plaintiff's for applying the momentum of the sley to the brake. It was argued that the patent was for a combination, and that there could be no infringement unless the whole combination of the same elements was used. This argument was overruled, Pollock, C. B., saying that if a portion of a patent for a new arrangement of machinery is in itself new and useful, and another person, for the purpose of producing the same effect, uses that portion of the arrangement and substitutes for the other matters combined with it another mechanical equivalent, that would be an infringement, and the plaintiff there had judgment. The defendants here use the pressure in the mains for the same purpose that the plaintiff does, and thereby complete the arrangement of the plaintiff's patent, the same as the defendant there used the momentum of the sley for the same purpose that the plaintiff there did, thereby completing the combination of that patent. These views do not differ from the decision in *Prouty vs. Ruggles* (16 Pet., 336) and like cases, where it is held that a patent for a combination of several parts to accomplish a part is not infringed by a combination of less of the same parts alone, or with other substantially different, to produce the same result. That case was put expressly upon the ground that neither any of the parts nor any portion of the combination less than the whole was new.

The patentee is entitled to the exclusive use of the whole of his patented invention, and if it is of a combination of numerous parts, including in it other new and useful combinations of less of the parts, he seems to be entitled to the exclusive use of these lesser combinations, as well as to the exclusive use of the whole. (*Sharp vs. Tifft*, 17 O. G., 1,282.)

The pumping apparatus of Flanders may be an improvement upon that of the plaintiff, and properly patentable as such, so as to entitle him to the exclusive use of those particular devices, but that would give him no right to use his devices to infringe the plaintiff's patent with, although this fact may be of importance in determining the amount of profits or damages due to such infringement.

The other patent is for a dash-pot combined with a safety valve upon water pipes subjected to great pressure, to steady the motions of the valve in opening and closing. The dash-pot is an old and well-known contrivance for steadying motion, but it had never been combined with such valves before. The defendants use a dash-pot in the same combination, but they claim they do not infringe because their dash-pot is different from the plaintiff's. The plaintiff's is closed at the top and receives water, in which the loose piston works, at the bottom from the main on which it is placed. The defendants' is open at the top and receives water there, and is closed at the bottom. Their operation in steadying motion is alike. The pressure of the water in the main may communicate some motion to the piston in the plaintiff's dash-pot which it cannot do to that of the defendants'; but that is not noticed in the patent. The dash-pots each accomplish the same result by the same means in substantially the same way. The combination is the same, and the use of theirs by the defendants infringes the patent of the plaintiff's. (*Machine Company vs. Murphy*, 97 U. S., 120.)

It has been urged in argument that the defendants only make and sell the Flanders pump, and that they do not infringe the plaintiff's patents, although their purchasers may have infringed by putting them into systems of waterworks. If all they did was to make and sell these pumps merely, probably they would not infringe by that alone; but the answer and proofs go beyond this. Flanders, in his testimony as to what works they have put up, does not limit what they did to making and selling the pumps merely. The effect of the whole clearly is, they participated and concurred

in putting in the whole by furnishing the pumps for that purpose, and this is sufficient to make them liable as infringers. (*Bowker vs. Dows*, 15 O. G., 510.)

Let a decree be entered that the first claim of the reissued patent and the other patent are valid; that the defendants have infringed both, and for an injunction and an account, with costs.

U. S. Circuit Court—Northern District of Illinois.

THE NATIONAL CAR BRAKE SHOE COMPANY *vs.* THE LAKE SHORE AND MICHIGAN SOUTHERN RAILWAY COMPANY. SAME *vs.* THE ILLINOIS CENTRAL RAILROAD COMPANY. —PATENT SHOE FOR CAR BRAKES. PATENT OF OCTOBER 6, 1863.

Drummond, J.:

1. Effect must be given to the whole of the description contained in the specification and drawings of a patent. Hence, if it can be ascertained that a patentee intended to divide his invention into two parts, and to describe and claim them as separate improvements, the patent must be construed according to his intention, so as to give full effect to each part of the invention.

2. Where a patentclaims, first, a combination of two parts so arranged that one can have a "lateral rocking motion" on the other, and, secondly, a combination of the same parts with two additional elements, "the whole being constructed and arranged substantially as specified," but not in terms referring to the rocking motion, the second claim is infringed by the use of its combination of mechanism, although the arrangement is such as not to permit any rocking motion.

Patent sustained.

The Cracking of Paint.

What is the cause of paint cracking? You may ask a dozen painters that question, and each will have a different answer. One will say, it has got too much oil in it; another, there is too much japan in it; again not enough oil in it; others, that your paint dries too quick; and so we might go on and fill pages with the answers that you would receive from different painters, for each will have a different answer. The general conclusion of observant painters is that the cracking of paint is caused more by the use of oil and hurried work than anything else.

A great many painters persist in mixing their paints to have them very elastic all the way through, thinking they will have a tough elastic surface that will give like rubber to the swelling and shrinking of the wood, without cracking, and would scarcely break apart if the panel were split in two. Well, we will admit they could get a very elastic coat, and providing it remained that way and never dry hard, it would be just the thing; but the paint is bound to dry hard some time, and any material will contract in drying. The elastic body of paint will continue to dry and contract, until its elasticity gets to its utmost limits, when it will give way and spread open in big cracks, looking the same as house painter's paint when it cracks.

To paint a job up with elastic coats of paint, it should go through a very long process, longer than anybody would want to give, the way painting is hurried now. The different coats should be put on very thin, and each allowed to dry thoroughly before another is put on. Putting on a number of heavy coats of any kind of paint or rough stuff as fast as you can, or before the under coat is dried through, will cause cracking of the worst kind, either before or after varnishing.

Paint too often is supposed to be dry, when really it is not half dry. It formerly took six months or more to get a job ready for finishing on the elastic principle, and then you would want good drying weather; but now you must paint a job through and through in a month, or even a shorter time, and the job supposed to last the same.

The quick process or flat coating can also be hurried so that it will crack, and crack badly too. Our ideas of obviating the cracking of paint are these: let every part of the wood be thoroughly primed with good fresh priming; prime inside and out, or use slush on the inside, which is just as good as priming, so that the water cannot act on the wood. Let the priming get perfectly dry, then mix every coat of lead, so that it will dry hard. Mix the filling with japan and varnish, so that this may dry firm and hard; use no oil in it. Have every coat dead color; do not have them with a gloss color, which is very deceiving, appearing dry, but when the subsequent coats are put on, they go into what is known as color cracks, caused by the under coats not being hard.

Do not apply the coats too heavy; have them as thin as possible to answer your purpose, and let each get thoroughly dry before putting on another. Place enough coats on to fill the grain of the wood, making a perfect surface. Then you will have on a body of paint firmly bound together, and thoroughly dry. When paint is thoroughly dry, it can shrink no more, as it only shrinks when in the process of drying, and if it does not shrink, it cannot crack; also in this kind of a body of paint, there is no moisture or oil to sweat out and destroy the luster of the varnish.

Painting of this description will not crack until the joints of the wood begin to give way, admitting water and damp atmosphere, which swells the wood along the edges of the joints, causing the paint to crack from the swelling and shrinking of the wood. Varnish may crack on top of the best painting ever done, and the underneath or foundation be solid. We have seen where the varnish on jobs was cracked terribly, but in taking the varnish off by the use of spirits of ammonia, found the filling as sound as it was possible to be.

If the paint is not well protected by varnish, it will perish in time, sooner or later, owing to how well it is protected. A job to be kept in good order should not be allowed to go for two or three years without having anything done to it; we have seen men who would complain because the painting did not last as long as the carriage, thinking, we supposed, that the one painting was enough. Once a year is enough to have a carriage varnished to be kept in order, though no rule is laid down, except when it commences to look as if it wanted varnishing, have it done; don't wait until it wants burning off before attending to it.

Nowadays, painters will paint jobs in two weeks, and wonder at the cracks. The blame is generally laid on the material, or on anything else handy and suitable, but the real cause is, finishing the job in two weeks, requiring the coats to dry as hard as possible, and trust to luck for results. —*Carriage Monthly.*

Astronomical Notes.

OBSERVATORY OF VASSAR COLLEGE.

The computations in the following notes are by students of Vassar College. Although merely approximate, they are sufficiently accurate to enable the observer to recognize the planets.

M. M.

POSITIONS OF PLANETS FOR DECEMBER, 1880.

Mercury.

Mercury can be seen only in the morning. On December 1 Mercury rises at 5h. 47m. A.M. On December 31 Mercury rises at 6h. 34m. A.M.

Mercury is at its greatest elongation west of the sun on the 12th.

Mercury passes Mars on December 23.

Venus.

Venus will be brilliant in the southwest all through December, setting later and later. On December 31 it sets about 8 P.M.

The moon passes north and east of Venus December 4.

Mars.

On December 1 Mars rises at 6h. 16m. A.M. On December 31 Mars rises at 6h. 15m. A.M.

Mars and Mercury are in conjunction on December 23. According to the "Nautical Almanac" Mercury is 1° north of Mars at 8 A.M.

Jupiter.

Although Jupiter is long past its perihelion, it is still the great light of the evening skies, coming to the meridian early in the evening, and at a good altitude for amateur observers in this latitude. Its altitude is about 51° to 52° through the month of December.

On December 1 Jupiter rises at 1h. 44m. A.M. On the 31st at 11h. 48m. A.M.

Saturn.

Saturn can be known by its position in regard to Jupiter. It follows Jupiter at a distance of 12½° on December 1, and 10° on the 31st.

Saturn is nearly 4° north of Jupiter in declination on December 1, and 3° north of Jupiter on the 31st.

Saturn rises at 2h. 20m. P.M. December 1; at 0h. 20m. P.M. December 31.

Saturn is stationary among the stars December 24.

Uranus.

Uranus rises at 11h. 49m. P.M. December 1; at 9h. 51m. P.M. December 31.

Uranus comes to the meridian at 6h. 14m. A.M. on December 1; at 4h. 16m. on the 31st, for this meridian.

PHENOMENA OF JUPITER'S SATELLITES.

December 1.—A little before 9 satellite I. enters on a transit.

December 2.—About 9:15 satellite I. reappears from eclipse.

December 3.—About 8:15 satellite II. completes a transit.

December 5.—Just before 8:15 satellite III. reappears from occultation.

December 8.—At 10 satellite I. is very near Jupiter, being about to make a transit.

December 9.—Between 8 and 2 satellite I. is missing in occultation.

December 10.—About 8:15 satellite II. enters on a transit.

December 12.—At 8 satellite II. is very near the planet, having just reappeared from eclipse.

About 9:15 satellite III. is occulted.

December 16.—About 9:45 satellite I. is occulted.

December 17.—A little after 9 satellite I. reappears after transit.

December 18.—At 8 satellite I. is very near Jupiter, having just appeared after eclipse.

December 19.—Satellite II. is missing in eclipse between 8 and 10.

December 24.—About 8:45 satellite I. enters on a transit.

December 25.—A little after 8:30 satellite I. reappears from eclipse.

December 26.—Between 8 and 10 satellite II. is missing in occultation.

December 30.—A little before 10 satellite III. reappears after transit.

A. K. FITZHUGH.

Decomposition of the Elements.

It has been known for some time, says the *Photographic News*, that simple relations exist between the spectra of the elements in a natural group, consisting in the homologous relations of the lines of the spectra. Similar relations are also found in the spectra of compounds. For example, cyanogen gives a peculiar spectrum, the more refrangible half of which is comparable to the carbon spectrum, and the less refrangible half to the nitrogen spectrum of the first order, and they are respectively homologous with these spectra; similar relations are observed with carbon monoxide.

As now the spectrum of cyanogen is homologous in one half with the spectrum of carbon, and in the other half with the spectrum of nitrogen, because it contains both these substances, in like manner similar cases might be inferred in the homologous relations of the spectra of certain elements.

Dr. Ciamician, of Vienna, carried this out exhaustively in the Academy of Sciences. He thinks the cause of the homologous relations of the spectra of the elements could be explained by the assumption that the elements are compound, and gives the following surprising explanations.

1. The spectra of the elements carbon, boron, beryllium, and magnesium are perfectly homologous with one another. These four elements consist, therefore, of the same material, which exists in different grades of condensation, which finds expression in the displacement of the homologous lines. The atomic weights of carbon (12) and boron are, in fact, near one another; the atomic weight of magnesium is double that of carbon (24). Cimiciancalls these groups "Carbonoide."

2. The spectra of silicium and aluminum are homologous with one another, and the more refrangible side corresponds with the spectrum of carbon, the less refrangible with that of oxygen. Silicium consists, therefore, of carbon and oxygen, corrresponding to 12+16=28 (atomic weight of silicium).

Aluminum contains the carbon in the form of boron and oxygen, as its atomic weight (11+16=27) indicates.

3. The elements of the alkaline earth metals have spectra, the more refrangible part of which corresponds with the spectrum of magnesium, and the less refrangible part with the spectra of the elements of the oxygen series. Therefore calcium, strontium, and barium consist of carbon in the form of magnesium, and oxygen in the condensation forms of sulphur, selenium, and tellurium, corresponding to the atomic weights: Ca=24+16, Si=24+4·16, Ba=24+7·16.

4. The elements of the oxygen group all consist of the same material, which is found in different stages of condensation; which finds expression in the displacement of the homologous lines, and in certain other peculiarities in the formation of the homologous groups of lines in the spectrum. The atomic weights of the elements of the series are: O=16, S=16+1·16, Se=16+4·16, Te=16+7·16.

5. The halogens all consist of fluorine and oxygen in different forms of condensation; the atomic weights of the elements of this group—Cl=19+16, Br=19+4·16, I=19+7·16—express these relations. In this series, as is known, the composition of single members has been conjectured for a considerable time, and they have been thought likewise to consist of fluorine and oxygen.

6. The spectra of the nitrogen group are homologous in the less refrangible part with the nitrogen spectrum, in the more refrangible part with the spectra of the elements of the oxygen group. The elements of the nitrogen group consist accordingly of nitrogen and oxygen in different grades of condensation, which agrees with the atomic weights: N=14, P=14+16, As=14+4·16, Sb=14+7·16.

If one relies on this hypothesis, then the remarkable relations of the atomic weights of the elements to one another appear perfectly intelligible. We have then, in the so-called elements of inorganic chemistry, really to do with homologous series, which can quite be compared with the homologous series of organic compounds, which has besides been already conjectured by different authors.

We see, further, that with increasing condensation of the material the metallic character is always more clearly marked; the higher members of a series have always more metallic properties.

It is probable that the present fundamental substance can be collectively referred to the typical elements—hydrogen, carbon, nitrogen, oxygen, and fluorine; it is not, however, implied that these are to be considered as the final components of the material.

The Load of a Freight Car.

A rapid increase has been going on during recent years in the amount of freight regarded as the maximum load of a car. Formerly 20,000 pounds was the limit; now, according to the Western Weighing Association, the average of the different classes of freight, as determined by the weights of 50,000 cars weighed during a period of six weeks, was from 23,750 for machinery to 29,925 for ore, the maximum in nearly all cases exceeding 30,000 pounds. Certain classes of freight reached, respectively, as high as 35,000, 37,750, 39,300, 39,600, and even, in the case of ore, to the enormous weight of 48,500 pounds, or more than 24 tons. The superintendent of the association is satisfied that the various articles of freight enumerated, 23 in number, will average fully 27,000 pounds per car, and the whole will not average less than 25,000 pounds per car. The fact that such loads can be safely carried now is due to the vastly improved condition of tracks as well as to the heavier construction of the car.