PRACTICAL MECHANISM.

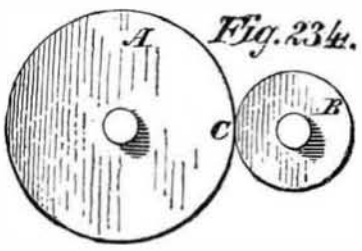
BY JOSHUA ROSE.

NEW SERIES—NO. XXXIX.

GEARING.

The term gearing is generally understood as meaning toothed wheels, which are said to be in gear, or geared together, when the teeth of one engage with those of another. The expression "a gear" always implies a toothed wheel. The term gearing, however, is frequently applied in connection with other qualifying words to distinctive parts of an engine or machine, as valve gear, slide gear, reversing gear, but in neither of these cases is it to be understood that those mechanical parts contain any toothed wheels or indeed wheels of any description. Wheels which communicate motion one to the other by simple contact of their surfaces are turned friction wheels, or friction gearing. Thus in Fig. 234 let A and B be two wheels that touch each other

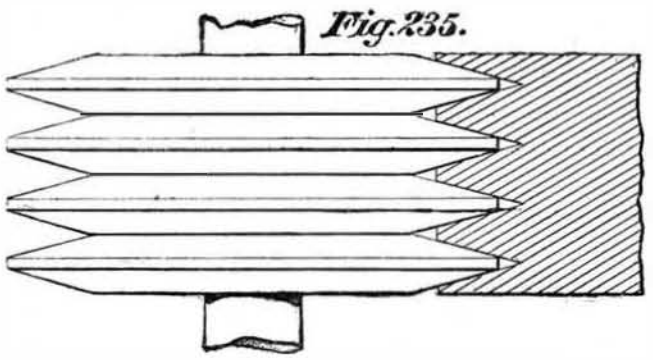
Fig. 234.



at C, each being suspended upon a central shaft; then if either be made to revolve, it will cause the other to revolve also, by the unassisted adhesion of the surfaces meeting at C. The degree of force which will be thus conveyed from one to the other will depend upon the character of the surface and the length of the line of contact at C; if the material is very hard and the surface highly polished, the force transmitted would be quite inconsiderable, but would be largely increased if the surfaces revolving against each other were of a rough character, as in the latter case the minute projections causing the roughness would act upon each other.

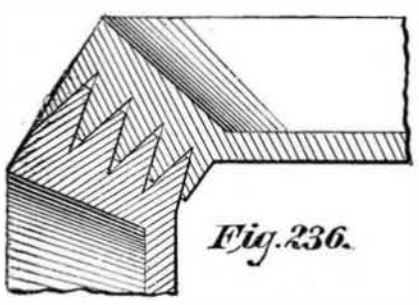
In this class of gearing great strain is put upon the bearings; and as the latter wear, the frictional contact becomes diminished, and the usefulness of the device soon becomes impaired. To obviate this defect, and to further increase

Fig. 235.



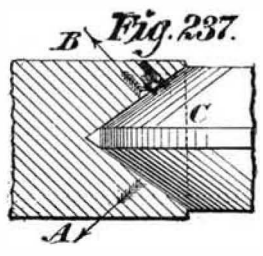
the power transmitted, the line of contact is increased by what is known as the "wedge and groove frictional gearing" which is shown in Figs. 235 and 236. In this case, not only

Fig. 236.



is the line of surface contact increased, but the strain due to the contact is so placed as to, in a great measure, counteract itself. Let us, for example, consider the strain placed upon one groove as shown in Fig. 237. The surface pressure on

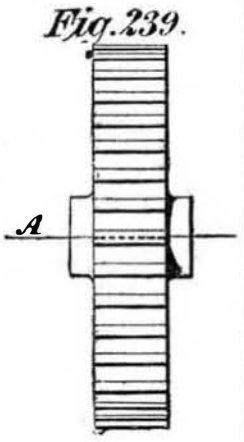
Fig. 237.



each side will be at a right angle to the face, or in the direction described by the arrows. A and B, one being in exactly opposite direction to the other. The surface contact acts to thrust the bearings apart. The line of surface acting to thrust the bearings apart being denoted by the dotted line, *c*. The relative efficiency of this class of wheel, however, is not to be measured by the length of the line, *c*, as compared to that of the two contacting sides of the groove, because it is increased from the wedge shape of the groove, and furthermore, no matter how solid the wheels may be, there will be some elasticity which will operate to increase the driving power due to the contact. It is to preserve the wedge principle that the wedges are made flat at the top, so that they shall not bottom in the grooves even after considerable wear has taken place. The object of employing this class of gear is to avoid noise and jar and to ensure a uniform motion. The motion at the line of contact of such wheels is not a rolling, but, in part, a sliding one, which may readily be perceived from a consideration of the following. The circumference of the top of each wedge is greater than that of the bottom, and, in the case of the groove, the circumference of the top is greater than that of the bottom; and since the top or largest circumference of one contacts with the smallest circumference of the other, it follows that the difference between the two represents the amount of sliding motion that occurs in each revolution. Suppose, for example, we take two of such wheels 10 inches in diameter, having wedges and grooves ¼ inch high and deep respectively; then the top of the groove will travel 31·416 inches in a revolution, and it will contact with the bottom of the wedge which travels (on account of its lesser diameter) 29·845 inches per revolution.

A spur wheel is one which has the breadth of the teeth parallel to the shaft axis, as in Fig. 239. The dotted line denotes the breadth referred to, and A represents the axis. A bevel wheel is one which has its teeth at an angle with the axis, as in Fig. 240. A crown or face wheel is one having its teeth at a right angle to its axis, as in Fig. 241. A miter wheel is one having its teeth at an angle of 45° to its axis, as in Fig. 242. An annular or internal wheel is one having its teeth convergent to its center. The roots of the teeth being at the largest diameter. Spur wheels act upon each other in the same plane. Bevel wheels act upon each other at an angle.

Fig. 239.



When the tooth of a wheel is made of different material from that of the teeth of the wheel with which it gears, it is termed a cog, but if in a pinion it is sometimes termed a leaf, while in a trundle it is termed a stave. A wheel which impels another is termed the driver or leader. The wheel impelled is termed the driven wheel or follower. A series of wheels geared together is termed a train. When two wheels are geared together the larger is termed the wheel, and the lesser the pinion. When a wheel is formed of a continuous web instead of having arms, it is termed a plate wheel.

The length of a tooth is the distance from its base to its extremity. The breadth of a tooth is the distance it extends across or upon the face of the wheel. The pitch line of the wheel is the circle upon which the pitch is measured, and it is the circumference by which the diameter or velocity of the wheel is measured. The pitch of a wheel is the distance of one tooth from the other, measured on the arc of the pitch circle, or pitch line, as it is usually called. The line of centers is the line between the centers of two wheels The radius of a wheel is the semi diameter, extending to the periphery, but in referring to the radius of a wheel, the pitch line is always, in practice, referred to. The radius is understood to be the distance from the center to the pitch line of the wheel.

The teeth of a wheel should be as small and as numerous as is consistent with the required strength. It is desirable that the number of teeth in a wheel should be prime to the number of the pinion, that is, the number of teeth in the wheel should not be divisible by the number in the pinion without leaving a remainder. This is advisable in order to prevent the same teeth coming together so often as to cause an irregular wear to the teeth. For this purpose an odd tooth is often introduced into a wheel, which is termed a hunting tooth. As an illustration of the desirability above referred to, suppose a pair of gear wheels are employed to drive a machine in which, as in the case of shearing machines for cutting plate iron, the duty is very severe, but lasts during, say, for example, one twentieth of the revolution of the gear wheel. If then the same teeth are always in gear or contact at the time the heavy duty is being performed, those teeth will rapidly wear away, because they sustain continuously this heavy duty, whereas by the employment of a hunting tooth, or by a prime number of teeth in the wheel, the heavy duty will be distributed over the various teeth. If, however, the revolutions of one wheel must be divisible without any remainder by the revolutions of the other, the number of teeth also must be so divisible.

We may now proceed to consider the principles that are to guide us in giving to the teeth of wheels their correct form or outline, so that the wheels when moved by them shall at as uniform a velocity as they would by the simple contact of their circumference. It is conceded by all authorities that there are an infinite number of forms of teeth which will enable one wheel to communicate equable motion to another, and it can be shown, say Willis and others, that within certain limitations, if any form of tooth be given, another may be determined which will work correctly with it. In actual machine practice the epicycloidal and involute curves have been universally adopted for wheel teeth on account of the facility and accuracy with which they may be mechanically described, and perhaps because they admit

Fig. 240.

Fig. 241.

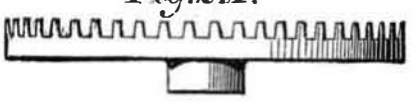


Fig. 242.

of ready and independent demonstration of their possessing the properties required for their duty.

Why Milk Sours during Thunderstorms.

BY MALVERN W. ILES, PH. D.

There have been various surmises in regard to this subject; none, so far as we have been able to learn, have been substantiated by experiments.

In order to see if milk did really sour during heavy thunderstorms, I made several observations which proved to me that this was not an erroneous opinion which is so commonly held by the dairymen. My experiments to arrive at the cause of the phenomena thus observed may be stated as follows:

I took skimmed morning's milk, filled a eudiometer tube (300 c.c.), then introduced 100 c.c. pure oxygen gas.

Then by the use of an ordinary battery, and a small Ruhmkoff coil, caused sparks of electricity to pass through the oxygen for five minutes. The current was then broken, the tube shaken up and allowed to stand for five minutes. The milk does not appear quite as opaque, and shows a noticeable acid reaction.

On continuing the current for five minutes longer, making in all 10 minutes, the milk curdles very perceptibly, and shows a decided acid reaction.

The contents of the tube on standing for twenty minutes had reached the consistency of ordinary sour milk or bonny-clabber.

From the above experiments it will be seen that the oxygen was converted into ozone, which we think may be stated as the cause for the rapid souring of milk during thunderstorms.

The increased acidity is due to the formation of lactic acid, and most probably some acetic acid, by means of the ozone. One or both these acids, then, causes the casein to be precipitated.

Submarine Explosions.

An interesting paper by Lieut. Andic, on the effects of submarine explosions, appears in the *Revue Maritime et Coloniale* for September. He concludes *inter alia* that gun cotton can develop in water pressures twenty times greater than a charge of powder of the same weight. It may be likened, for rupture of hulls, to 3·75 times its weight of powder. The measurement of the wheat-sheaf jets of water leads to no plausible result in investigation of the sphere of action. Apart from the advantage of its less volume, and its harmless character in handling, gun cotton is less advantageous than 3·75 times its weight for charging fixed torpedoes. Powder may be used at much greater depths than those which have been fixed as limits. Beyond certain depths, it takes considerable charges to obtain at the surface a sphere of action of 7·50m. An immersed torpedo of 2,000 kilogr. of powder, 40m. from the bottom, is capable of making a hole 6 meters in diameter in a ship above it. There is a considerable difference between the lateral and the vertical effects of a torpedo, and in England attention is directed mainly to utilizing the vertical effect, by uniting torpedoes in groups to be fired simultaneously.—*English Mechanic.*

Submarine Cable Statistics.

Of submarine cables, private parties own 149; miles of cable 59,547; miles of wire 65,535. Governments own 420 cables; 4,442 miles of cable and 5,725 miles of wire. Norway has 193 cables, Sweden 4, Denmark 29, Holland 18, Russia 3, Germany 46, Turkey and Greece 13, Italy 12, Spain 6, France 26, and Great Britain 52. The Anglo-American company has the longest submarine cable in the world, 2,585½ nautical miles, and has five Atlantic cables in all, besides twelve other cables, a total length of 12,315 miles. The Eastern Telegraph Company has 48 cables, with 21,883 nautical miles.

A New Autographic Process.

In the Belgian *Bulletin du Musée*, M. Hannot describes the following new autographic process. The writing or drawing is made upon any kind of paper, which should, however, not be very thick. A special ink is used, composed of gum arabic or gelatine ⅜ ozs., water saturated with bichromate of potash 1 quart, and sufficient Indian ink to color the whole. The gum is first dissolved in the solution and the ink afterwards added. The preparation must be kept sheltered from the light, and when used a portion should be poured out in an inkstand of black glass. When the drawing is finished it is exposed to light, whereby the lines are rendered insoluble.

A plate of zinc or a stone is then prepared and polished with emery, and the drawing is placed upon it face downward. Above the latter is laid a sheet of paper covered with gum arabic, and above this two or three sheets of dampened blotting paper. The whole is then pressed. The moisture in the blotting paper reaches the gummed paper, and the gum, dissolved, traverses the autographic paper and affects the zinc or stone everywhere except where the insoluble lines of the design have prevented its passage. A roller of greasy ink may then be passed over the plate, and the grease will adhere only to the lines which are not covered with moisture. Printing is then done in the usual way.

Phosphorescence of Quinine.

If some sulphate of quinine is strewn over a sheet of smooth paper and exposed to a heat of from 120° to 140° Fahr., by means of a plate of metal, it becomes phosphorescent when stirred with a glass rod. Valerate of quinine exhibits the same phenomenon without heat being applied, if the crystals are rubbed in a mortar. It is said that the appearance is only noticed when the valerate contains an acid prepared directly from the root of valerian.

IMPROVED BORING MACHINE.

Machinery of some sort for boring is almost indispensable in all wood-working establishments, and some of the contrivances in every-day use for that purpose are no longer economical in view of the improvements now made in this as well as the other branches of wood-working machinery.

The boring machine illustrated herewith is one of several sizes and styles built by Walker Brothers, Philadelphia, and is a heavy and substantial, yet easy working machine, designed for straight and angle boring of all kinds, the spindle carrying bits up to 2 or more inches in diameter, and having a capacity for boring to the depth of 12 inches.

The frame or standard is a coned casting in one piece, having a broad base, and is quite firm and rigid throughout. The work remains stationary upon the table, which may be adjusted to the proper height or angle, and the bit is brought down and fed through by the foot of the operator on the lever or treadle below. This treadle is provided with a stop to regulate the depth of cut, and with the upward stop the travel of the spindle may be regulated for thick or thin stuff.

The spindle is balanced by means of the adjustable weight on the lever above, and will return when the pressure of the foot is removed. The table is provided with two adjustments for angle boring, and a gage that may be removed when not in use, the whole being raised and lowered by simply turning the hand wheel underneath.

The proper range of speed is given for large or small bits by means of cone pulleys, and the countershaft may be set so as to run the belt from any direction and not interfere with parts of the machine.

This boring machine is furnished when desired with a full set of auger bits, including a small universal chuck for holding all kinds of straight shank bits or drills. For further information address the manufacturers, Messrs. Walker Brothers, Nos. 73 and 75 Laurel St., Philadelphia, Pa.

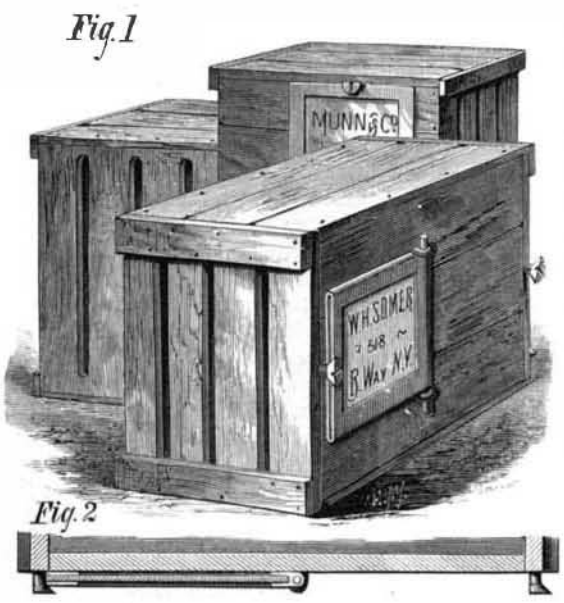
Preparation of Celluloid.

Paper is treated by a continuous process with 5 parts of sulphuric acid and 2 of nitric acid, which converts it into a sort of gun cotton. The excess of acid is removed by pressure, followed up by washing with abundance of water. The paste when thus washed, drained, and partially dried, is ground in a mill, mixed with camphor, ground again, strongly pressed, dried under a hydraulic press between leaves of blotting paper, cut, bruised, laminated, and compressed again in a special apparatus suitably heated. It is said to be hard, tough, transparent, fusible, becoming plastic and malleable at 125°. It ignites with difficulty, is decomposed suddenly at 140° without inflammation, and gives rise to reddish fumes. It is inodorous, and does not become electric on friction.—*English Mechanic.*

IMPROVED LABEL HOLDER.

The invention herewith illustrated is particularly intended for use in sending butter, eggs, fruit, or other articles by return package or crate.

Attached to the box or crate is the card holder, A, made of sheet metal or other suitable material, in the shape of an



open frame, the frame being grooved in such a manner that a card may be slipped into it from the outer end.

At the inner end of the holder are pins projecting at top and bottom; or a wire may be fastened in the inner end of the frame, and its ends project to form such pins. These pins are held to the box or crate by means of staples driven into the same over said pins, thus hinging the card holder to the box in such a manner that the holder may be turned with either side outward, and it is held by means of half-headed screws or hooks. The card of any house to which the box or crate is to be shipped may be inserted in the holder, and on the obverse side of the card the return address is written. All the consignee has to do when he desires to return the package is to turn the screw or hook on one side, reverse the holder, and fasten it by the screw or hook on the other side. For further information, address W. H. Somers & Co., Hume, Alleghany County, N. Y.

WALKER BROS.' VERTICAL BORING MACHINE.

Dr. Isidor Walz.

Isidor Walz, Ph.D., died in New York city on October 25. He was born in Bavaria May 5, 1846. He emigrated to the United States in 1859, and graduated at Columbia College in 1864. He studied chemistry under Bunsen and Erlenmeyer at Heidelberg, and received the degree of Ph.D. in 1867. He practiced his profession in this city, and in 1870 became editor of the *Manufacturers' Review and Industrial Record.* He conducted this paper with marked ability until October, 1876, when his declining health caused him to undertake a trip to Europe. Last month on his homeward journey he contracted the disease, pneumonia, which terminated his life.

Recent Investigations on Hydrophobia.

Hydrophobia has of late been extraordinarily prevalent in in London. Hardly a day passes, says the *Lancet*, without some fresh cases being recorded, and the attention of the medical profession has been closely directed to the nature of this most terrible disease. The data thus far gathered are valuable, not so much as establishing new facts, but in corroborating and shedding more light on some which have hitherto received little notice. From the conclusions now reached it appears that a sharp distinction is drawn between mental hydrophobia and the genuine disease. An adult, when bitten by a dog supposed to be rabid, passes through a period of intense mental perturbation, suffering all the agonies of doubt, apprehension, and foreboding. These mental disturbances induce symptoms closely resembling those of the genuine disease. The manifestations of hydrophobia in man are perversions of the nervous centers, and disturbances of the reflex center and highest psychical organs. The former is tolerably uniform, the latter extremely variable. In one case reported by the *Lancet*, there was little mental disturbance, very slight wandering at the close, and none of the wild paroxysmal furor which is commonly so conspicuous and so terrible a feature of the disease. In another case the psychical disturbance was so predominant that the patient was taken to an asylum as a simple lunatic.

The symptoms of true rabies are not always alike. Its approach may generally be detected by some alteration in the manner and habit of the tainted animal. In some, which are naturally bright and lively, unusual dullness, whilst in others, which are of the opposite disposition, unnatural vivacity are occasionally the premonitory symptoms. There is a remarkable variation in the period of incubation. The disease may be latent in the system for as long as three years. This accounts for the outbreak of the disease in apparently healthy dogs. The popular idea that a person once bitten has a peculiar liability of developing the disease at intervals of seven years after the occurrence is sheer nonsense. Three years seems to be the longest period of incubation known.

The "respiratory spasm" is a conspicuous feature in every case. It is compared by one to the "hurried or intermitting gasping one sees in a child attempting to drink when sudden thirst has been induced by recent violent exertion," and by another to the inspiratory spasms witnessed "when a cold shower-bath is administered to an individual." It is excited not only by an attempt to drink liquids, but also by mental impression, and the sight of water, or sound of running water, will bring it on.

Underground Telegraphs.

Between Berlin and Halle an underground telegraph wire has been in use for one year, and underground wires are about to be laid between Berlin and the cities of Cologne, Frankfort, Strasbourg, Breslau, Hamburg, Kiel, and Königsberg, thereby dispensing with posts and insulators, and avoiding the cost of their maintenance. The copper wires which convey the electric current are enclosed in wrought iron pipes, and are hermetically enclosed by insulating material, which protects them from the action of air and water, and prevents oxidation.

A CHEAP vinegar consists of 25 gallons of warm rain water with 4 gallons of molasses and 1 gallon of yeast. The mixture can be used after it has been allowed to ferment.