SCIENCE

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THE TRIPP ANTI-FRICTION ROLLER-BEARING.

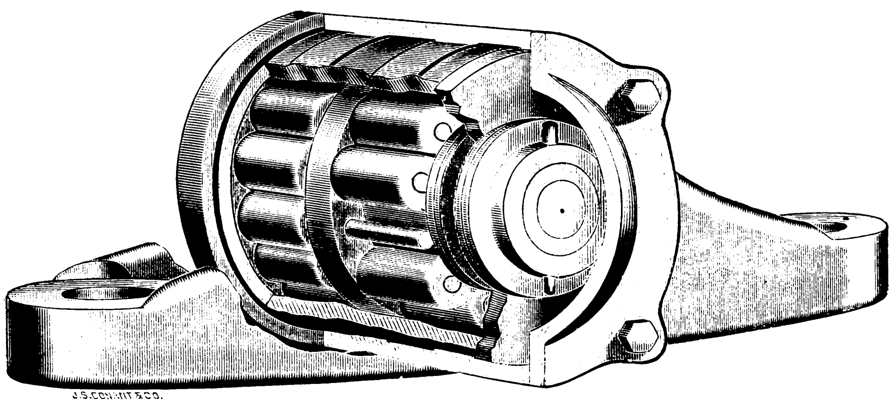
THIS bearing is adapted for use on car axles, dynamo-shafts, and similar places where there is high speed or heavy pressure, or both. It consists of a double set of rollers held in place by a sort of skeleton frame, and enclosed in a box of suitable construction. The rollers are of steel, of the same degree of hardness as when cut from the bar. They fit snugly around the shaft or axle, and bear against the inside of the box, revolving on their axes, and travelling around with the shaft, thus reducing the friction to almost zero, or, in other words, to rolling friction. Mr. J. A. Dyblie of the Chicago Arc Light and Power Company turned a six-inch shaft with his thumb and finger to and fro with the greatest ease.

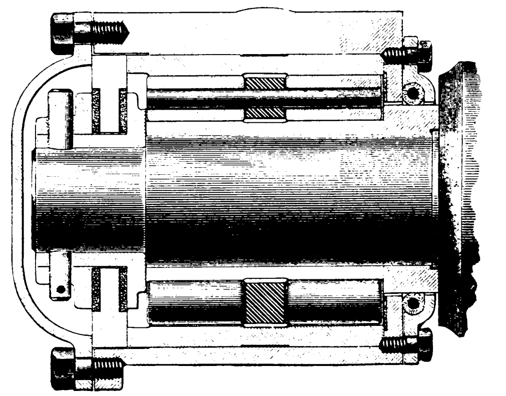
The construction of the device may easily be understood by an inspection of the accompanying illustrations. Fig. 1 is a perspective view, with part of the outer shell or box broken away to show the interior, and one of the rollers removed to show the pin upon which it revolves. This pin, it must be remembered, performs no duty except to keep the roller in place when the shaft is removed, and to keep the roller in line with the shaft when in use. It bears no part of the weight of the shaft or axle, that all being transferred to the box by the rollers. Fig. 2 is a sectional view of the bearing, showing a very important feature; namely, the thrust-plate and collars, which take the end-thrust of the axle caused by the side-motion of the cars, as in going around a curve. This feature is shown at the left of the sectional view. The thrust-plate is bolted firmly to the box, and has two leatheroid collars — one on each side — between it and the thrust-collars, which latter are keyed to the end of the axle. This thrust-bearing has an area of sixty-three square inches, in contact at both ends of the car-axle, while that of the master car-builders' standard axle has an area of only seventeen square inches, in contact at only one end of the axle at a time.

It is stated, that, in a set of these bearings on a train running between Boston and Philadelphia, the rollers show a reduction in diameter of less than five one-thousandths of an inch, after a total service of forty-five thousand miles. They also remain uniform in size from end to end. This shows a very small amount of friction. Much of the long life of these rolls is doubtless due to the fact that the bearing is made dust-proof by a cap at one end and an expansive packing at the other, which, it is claimed, keep the lubricating material absolutely free from dust and water, so that it does not require renewal during the life of an ordinary chilled car-wheel.

Another advantage claimed is, that, when the brake is strongly applied, the strain comes on the rolls opposite the brake-shoe, causing no cramping, the axles turning as freely in the boxes as ever. In ordinary bearings the tendency is to crowd the journal out of the brasses, thereby reducing the bearing surface, inducing a tendency to heat when the journal returns to the centre of the box upon the release of the brake.

In a test of a two-inch journal in one of these bearings, under a pressure of four hundred pounds, without lubrication, it made a record of six thousand revolutions a minute for two hours without heating. Under a five-thousand-pound street-car, holding the regular number of passengers, a set of these bearings has been in use over two years with only one lubrication; and, though the car has been off the track the usual number of times, the bearings show no detrimental wear. They are now doing good service on about twenty street-cars, and are being applied to electric car-motors, stationary motors, shafting, and in various other places where a minimum of friction is desired.





ROLLER-BEARINGS FOR REDUCING FRICTION.

FUNGOUS DISEASES OF PLANTS.

VARIOUS rusts, smuts, mildews, blights, and similar diseases of cultivated plants, have been generally known and dreaded since plants began to be cultivated. Any understanding of the cause of these troubles, of the conditions of their occurrence, and of their relations to each other and to the plants they infest, is a matter of comparatively recent acquisition even among botanists. Among American farmers and gardeners it is only recently that intelligent inquiry and thought regarding these important sources of loss have been awakened, and they are but just beginning to be popularly spoken of as fungous diseases. With this increased popular interest has naturally arisen an increased interest in their scientific investigation, which is as yet but fairly begun, and in the practical application of our technical knowledge in devising ways and means for checking the spread and preventing the ravages of the pests.

In the October bulletin of the Hatch Experiment Station of the Massachusetts Agricultural College, Professor James Ellis Humphrey, professor of vegetable physiology, summarizes the results of his investigations on the subject. It is doubtless true that to the average reader the term "fungus" carries with it no definite idea. This is due partly to the newness of the popular use of the term and the meagreness of generally accessible sources of information concerning the fungi, and partly to the inherent difficulty and technicality of the subject. To obtain a clear notion of organisms so small as to be barely recognizable by the naked eye, and requiring high powers of the microscope for their study, yet with such apparently disproportionate capacities for mischief, is not easy. It is for this very reason all the more important, that, in a discussion of fungous diseases intended for popular information, an attempt should be made at the outset to remove, so far as may be, this fundamental difficulty.

In the first place, then, a fungus is a plant — as truly and essentially a plant as the corn-stalk or rose-bush on which it grows. Yet it is not only much smaller, but also much simpler, than these. While the plant-body of the corn or rose shows much specialization of structure, having the various vegetative functions of the plant performed by distinct organs (the root, stem, and leaves), very many plants show no such specialization, but have all their vegetative functions performed by the whole plant-body, which then needs no variety of organs. Of the latter class of plants are the rockweeds and sea-mosses, the fresh-water pond-scums and the fungi, which are obviously much simpler and more primitive plants than those with roots, stems, and leaves. In all true fungi the plant-body consists of numerous simple or branching white threads which spread over the surface or through the substance of the object on which the fungus grows. These threads constitute the so-called "mycelium" of the fungus, and are comparable with the more elaborate plant-body of other plants, since they perform all its vegetative functions.

Equally important with its own healthy growth is the provision by any plant or animal for the perpetuation of its kind, and to this end it develops organs of reproduction. In many of those plants provided with root, stem, and leaf, these reproductive organs are grouped into a structure called a flower; and such plants are known as "flowering plants." They all produce, by the further development of certain parts of their flowers, structures known as "seeds," which can, under favorable conditions, develop into new plants similar to that which produced them.

Fungi do not produce flowers, and they vary greatly in their reproduction; but they all agree in producing bodies called "spores," — much simpler than seeds, as would be expected, but analogous to seeds in their ability to develop, under favorable conditions, into plants similar to those which produced them. These spores are usually produced on special fruiting or reproductive threads, which grow from the vegetative threads of the mycelium of the fungus. The reproductive threads may remain separate, thus producing their spores free in the air; or they may become interlaced or consolidated into a complicated fruiting structure, on which the spores are produced either superficially or in cavities, from which they finally escape into the air. The spores of fungi, being so small and light, are readily taken up and widely spread by currents of air, and are easily carried by insects from plant to plant. In such ways a fungous disease may spread from a single insignificant case until it becomes epidemic over a large area.

In the course of its life-cycle, the ordinary flowering plant passes from the seed, through the seedling, to the adult plant, bearing flowers and then seeds like that from which it grew. Many of the fungi, however, pass through a much more complex life-cycle, during which a given fungus may produce several kinds of spores, and assume several forms so unlike each other that they can be recognized as different stages of the same plant only by careful, patient cultivation and study. It is convenient to select some one stage of such a variable fungus as its perfect or adult form, and it is natural and logical to regard as such that stage in which the fungus shows the greatest elaboration of structure, while the simpler stages through which it passes are commonly called "imperfect forms. This tendency of fungi to variety in form, or "pleomorphism," as it is called, greatly increases the difficulty of their study, and complicates those problems which concern the successful combating of fungous diseases.

A question which very naturally suggests itself is, "Why do fungi attack and cause diseases of other plants, instead of living independently?" This question involves matters of the greatest interest and of fundamental importance and significance. It is well known that all "green" plants owe their characteristic color to the presence of a definite pigment known as "leaf-green," or "chlorophyl," which is so generally present among the higher plants, that to most minds the very word "plant" carries with it the idea of greenness. Now, the possession of chlorophyl is the pre-eminent feature which gives to plants their all-important place in the economy of nature. No living thing can continue to live on inorganic substances, but all require as food some of those materials of comparatively complex chemical composition known as organic substances. The materials furnished by the earth, the air, and water are all of simple composition and unorganized; but in leaf-green we have the connecting link, the means of bridging the interval between the inorganic and the organic. Professor Humphrey does not discuss the process in detail. He thinks it sufficient for present purposes to say, that, in Nature's laboratory of the leaf, some of the simple constituents of air and water are combined, by the action of leaf-green in the sunlight, into the complex organic compounds which serve the plant as food. The chemistry of this remarkable process is not well understood, but the commonest permanent form in which these food-materials appear is that of starch.

Now, as was noticed above, the threads of the fungi are white, uncolored; that is, they contain no leaf-green: consequently the fungi cannot elaborate their own food-material, but must obtain it, ready elaborated, from some other source. Evidently the available sources of organic food-supply fall under two heads, — living organisms; and dead organic matter, commonly decaying. On this basis, the fungi may be divided into two classes, — those which derive their nourishment from other living things, and those which live on the remains of dead organisms. The latter, known as "corpse-plants" or "saprophytes," include the moulds, toadstools, and many other fungi; but the first-named group is that which at present is of interest, since it contains the various groups mentioned at the beginning, which live on or in the bodies of other living plants at their expense, and cause extreme weakening or even the death of the affected plants. Such fungi are known as "parasites," and the plants they attack are called their "hosts." This distinction between saprophytic and parasitic fungi is a very useful one; but no sharp line can be drawn between the two groups, since some fungi seem to be able to live either as parasites or as saprophytes, while it is probable that very many pleomorphic fungi are parasites in some of their forms, and saprophytes in other stages of their life-cycle.

Finally, the interesting fact may be noted, that any given parasitic fungus is usually restricted in its capacity for harm to a single host-plant or to a few closely related ones; though, on the other hand, closely related fungi may attack plants of widely different relationships. Thus, the mildew of the lettuce and that of the onion are very closely related fungi; yet neither mildew can attack the host-plant of the other, since the structural resemblances are few and the relationship remote between the lettuce and the onion.

From the above facts may be derived a few important principles for guidance in attempts to avoid or check the ravages of fungi among plants cultivated for use or beauty. Since the mycelium of a parasitic fungus grows usually within the tissues of its host-plant, it is too late to try remedies after a plant is once infected. It is true that a few fungi are superficial in growth, and a treatment may perhaps be found which shall destroy such parasites without harm to the host; but in most cases the aim must be to fortify exposed plants against infection by the timely application of protective solutions or mixtures, which shall prevent the germination of the spores which fall upon the plant so treated. Some progress has been made in this direction, and some results have been reached which justify hopes of ultimate general success in largely avoiding the present enormous annual losses resulting from fungous diseases.

The treatment which now gives promise of most general applicability and efficiency is the spraying of the plants with a solution of sulphate of copper (blue-stone) or with one of the preparations in which it is the important ingredient, known as "eau celeste," "Bordeaux mixture," etc. It seems very possible, too, that plants may be fortified against the attacks of parasitic fungi, or their susceptibility to such attacks be largely diminished, by special fertilization, for the purpose of introducing into the plant substances which, while not interfering with its growth, shall make it a less congenial soil for the growth of fungi. The line of investigation here suggested has not yet been followed out, although it offers an opportunity for chemico-physiological work which may yield important results. It is obvious, also, that a vigorously healthy plant will resist the fatal influence of parasites far better than a poorly nourished one.

Much may be done, after a plant is too far gone to be saved, to prevent further spread of the disease, by removing and destroying the diseased parts. It is not sufficient, however, to throw the portions removed into the rubbish-heap: the spores must be actually destroyed, and this can be effectually done only by burning. A considerable number of fungi produce, in the plants on which they live, resting-spores, which ordinarily remain on or near the ground in dead leaves or stubble, survive the winter, and, germinating in the spring, infect the new growth. In these cases the danger of a severe attack in the following year can be greatly lessened by clearing up and burning all such sources of infection.

Numerous instances can be cited of more or less common weeds or wild plants so closely related to certain cultivated plants that they are liable to the attacks of the same fungi, and so serve to perpetuate those fungi, and to infect the related cultivated plants when growing near. Evidently, then, such plants should be carefully and thoroughly exterminated wherever they may prove a source of danger.

Professor Humphrey then went on to speak of the application of the foregoing facts and principles in the consideration of a few particular fungous diseases.

W. T. DENNIS, commissioner of fisheries for Indiana, has issued a call for a State convention of the disciples of the rod and reel, and dog and gun, to meet at Indianapolis, Ind., on Thursday, Dec. 19, at noon.

A NEW RECORDING PRESSURE-GAUGE.[1]

IN designing the recording pressure-gauge herewith illustrated, the object was to produce an instrument which would be fundamentally simple, and consequently reliable, and which could be placed upon the market at a moderate cost.

Fig. 1 represents the instrument complete, and ready for application. Fig. 2 shows the pressure-tube with the inking-pointer attached; the front of the case, dial, and cover of clock, being removed. The pressure-tube *A* is of flattened cross-section, and bent into approximately a sinusoidal form. A flexible strip *B*, of the same metal as the tube, is secured at the ends and along the bends, as shown in Fig. 2. The bent tube may be considered as a series of Bourdon springs placed end to end.

Pressure applied to the tube produces a tendency to straighten each bend, or collectively to elongate the whole. This tendency to lengthen the tube is resisted by the flexible strip *B*, and thereby converted into a multiplied lateral motion. The inking-pointer is attached directly to the end of the pressure-tube, as shown in Fig.

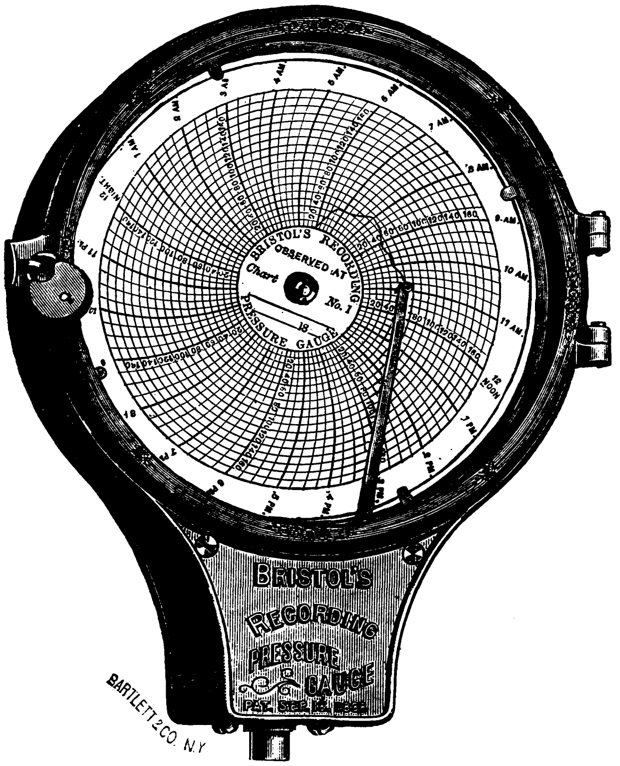


FIG. 1.

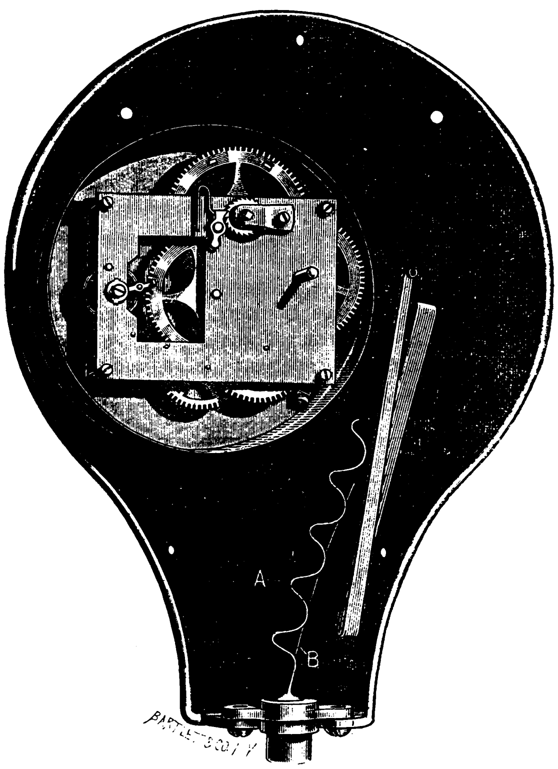


FIG. 2.

2, from which it will be seen that the usual mechanism and multiplying-devices are dispensed with, since the motion of the tube itself is positive and of sufficient range. The special advantage of this is evident, considering that in all other pressure-gauges the movement of the tube or diaphragm is small, and requires a system of mechanism to multiply the motion many times before it is available for indicating purposes. These multiplying-devices must be delicately constructed and properly cared for, and even under the most favorable conditions they are liable at any moment to be a source of error.

In the instrument illustrated the tube is designed for a range of one hundred and eighty pounds per square inch; for other ranges its sensitiveness may be varied at will by changing its proportions, as length, shape of cross-section, or thickness. The printed charts for receiving the record make one revolution in twenty-four hours, and are provided with radial arcs and concentric circles, the divisions on the radial arcs corresponding to differences in pressure; while those on the concentric circles correspond to the hours of the day and night.

During the past year and a half, several of the instruments have

[1] Paper read by W. H. Bristol of Hoboken, N.J., before the American Society of Mechanical Engineers, at its meeting, Nov. 21, 1889.