ELECTRIC INDUCTION BY STRESS.

Joule has shown that when a bar of iron is magnetized by means of a helix and electric current the bar is elongated appreciably. These elongations have been measured by Prof. E. A. Dolbear.

While undertaking some experiments in December, 1878, it occurred to me that the inverse of this ought to be true, namely, the forced elongation of a bar of iron, surrounded by a helix, would give cause for an electric current through the helix and connections. A series of experiments followed which completely verified the supposition, a recital of which may be of interest. The publication of them was deferred from time to time in the hope of more varied experiments, and in the possible discovery of like experiments by others.

By placing one branch of a sounding tuning fork near the pole of an electro-magnet, the coil of the latter having a Bell telephone in circuit, the tone of the fork is found to be reproduced in the telephone. But this is like using a Bell telephone for a transmitter, the branch of the fork in the present case serving for an armature, as does the diaphragm in that instrument. Again, when an iron bar is fastened at its center and made to vibrate longitudinally near an electro-magnet, a telephone in circuit will speak, and for the same reasons as before. Remove the core of the magnet and the sound is still heard at the telephone, and it is not necessary that the bar be a magnet. Bars of iron were selected that possessed a minimum amount of magnetism, in fact an almost inappreciable magnetism, and still a loud sound was emitted by the telephone.

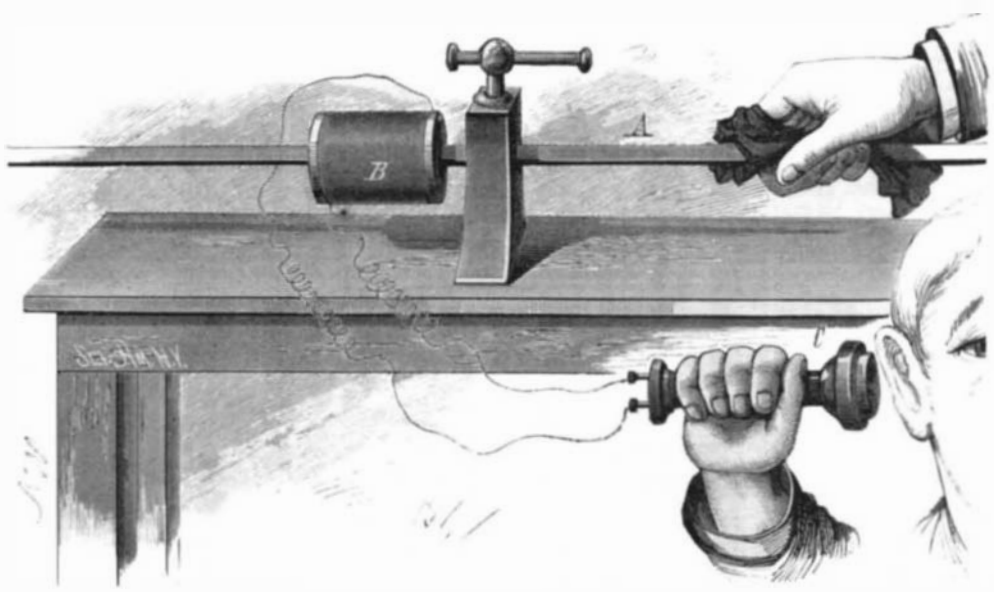
The helix used had no iron about it when the core was removed, and the opening for the core was large enough to encompass the bar without touching it. The bars used were several times the length of the helix.

At first it was supposed that the *motion* of the iron longitudinally was chiefly concerned in the production of sound. On this supposition the sound would diminish as the helix was moved toward the middle of the bar where it was firmly secured in a clamp for longitudinal vibration. But instead of this, the intensity was increased; and to such an extent that the auditor at the telephone in a distant room could positively say whether the coil was at the end or at the middle of the longitudinally vibrating bar. This made it clear that the sounds observed were not to be explained altogether on the ground of vibratory motion of the particles of the bar, because the motion of the bar at its middle is *nil* when clamped at this point and vibrating longitudinally at its fundamental; while at the ends we have a maximum degree of vibratory motion. But at the middle of a bar thus conditioned we have a node, and the strains are here known to be those of extension and compression and at a maximum for the bar, while at the ends the alternating strains are *nil;* that is, where the motion is greatest the strains are least, and *vice versa.* It seems, therefore, certain that at the middle the sound is chiefly due to the vibratory stresses, while at the ends it is almost entirely due to motion.

The engraving shows the apparatus. Rods were used which were from one-quarter to one-half inch in diameter and three feet long The coil was about three inches long, and so connected with the free circuit wires that it could readily be moved along the rod. As the clamp prevented placing the coil exactly at the middle of the bar, the latter, to test this point, was taken out and suspended by two filaments so light as not to interfere with the vibration, and the bar made to vibrate longitudinally by striking on the end with a mallet. The coil was placed directly at the middle and also shifted to right and left, but the sound was still loudest at the middle. Sounds produced by the transverse vibrations, now accidentally occurring and mixing with those due to the longitudinal vibrations, were heard, but were readily distinguished by the pitch of tone. These were separated from the above consideration of longitudinal vibrations.

To further test the matter of electric induction by stress, a rod was passed through the coil, and the rod put under tension in a testing machine. A galvanometer now placed in the circuit became very active as the strain was put on. The bar was an ordinary three-eighths rod of commercial bar iron. It was at once found to be permanently stretching, and the galvanometer needle was all the while flying about as the extension continued. When the bar was removed it was found to be strongly magnetic, much more so than it could have been when put in. It was also heated. It therefore seemed difficult to determine whether the observed currents of electric induction were due to strain, stretch, magnetism, motion, or heat, in part or together.

A piece of white chilled cast iron was then tested to 42,000 lb. compression, and found to resist the full power of the machine without crushing or set. The coil was then placed around the rod, and the test for stress-electric induction applied. Under compressive strains the needle gave unmistakable evidence of electric currents, though they were much feebler than in the previous case of soft iron.



MANNER OF PRODUCING ELECTRIC INDUCTION BY VARYING STRESS.

Experiments on steel bars, not magnetized, gave appreciably the same effects as iron bars. Magnetized steel was not tried, but it is presumed that at the end of the bar magnet vibrating longitudinally the sounds would be intensified, while at the middle of the bar, normally magnetized, the sounds probably would not materially differ from those obtained from non-magnetic bars.

A few other metals were tried, copper and brass particularly, but no sounds were heard from them. These experiments, though far from being complete and exhaustive of the subject, warrant us in the following conclusions, namely:

1st. That the fact of Joule, of the distortion of bars of iron by magnetization with electric currents, is operative in the inverse order, namely, distortion of bars by mechanical force induces electric currents in surrounding coils.

2d. Most other metals than iron or steel give but feeble if any observable results of stress-electric induction.

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RECENT INVENTIONS.

An improved tip for lamp-wick tubes has been patented by Mr. Hamilton B. Follett, of Brooklyn, N. Y. The object of this invention is to produce a very brilliant and regular flame in a kerosene lamp or stove, and to prevent any irregular or undue carbonizing of the wick. It consists in a small plate of metal, which passes edgewise and longitudinally over the middle of the upper edge of the wick tube, a short distance above.

Mr. Alfred I. E. Knight, of New York city, has patented a convenient inkstand or cabinet constructed with means for holding pen holders, sponges, rules, etc., and also a central removable panel, ornamentation, or calendar, and formed with surfaces adapted for emblematical or lettered advertising.

An improved apparatus for stowing cotton bales in vessels has been patented by Mr. John F. Taylor, of Sharon Springs, N. Y. The object of this invention is to facilitate the stowing of cotton bales in vessels, and enable the stevedores to stow a much greater quantity in a vessel than is possible when the stowing is done in the ordinary manner.

Mr. George Hill, of White Hall, Ill., has patented an improved stew pan which can stand very intense heat without breaking, has a support that admits of a circulation of air under the vessel, and has ears for fastening the bail, which are so protected that they cannot be broken off by slight jars or shocks, as is the case with the ears of the ordinary earthenware pan.

Pocket scales designed especially for physicians practicing in the country and in small towns, where it is necessary for them to carry and weigh out their medicines, for family use in weighing medicine, and for prescriptions and other delicate weighing, have been patented by Mr. Isaac S. Hopkins, of Oxford, Ga.

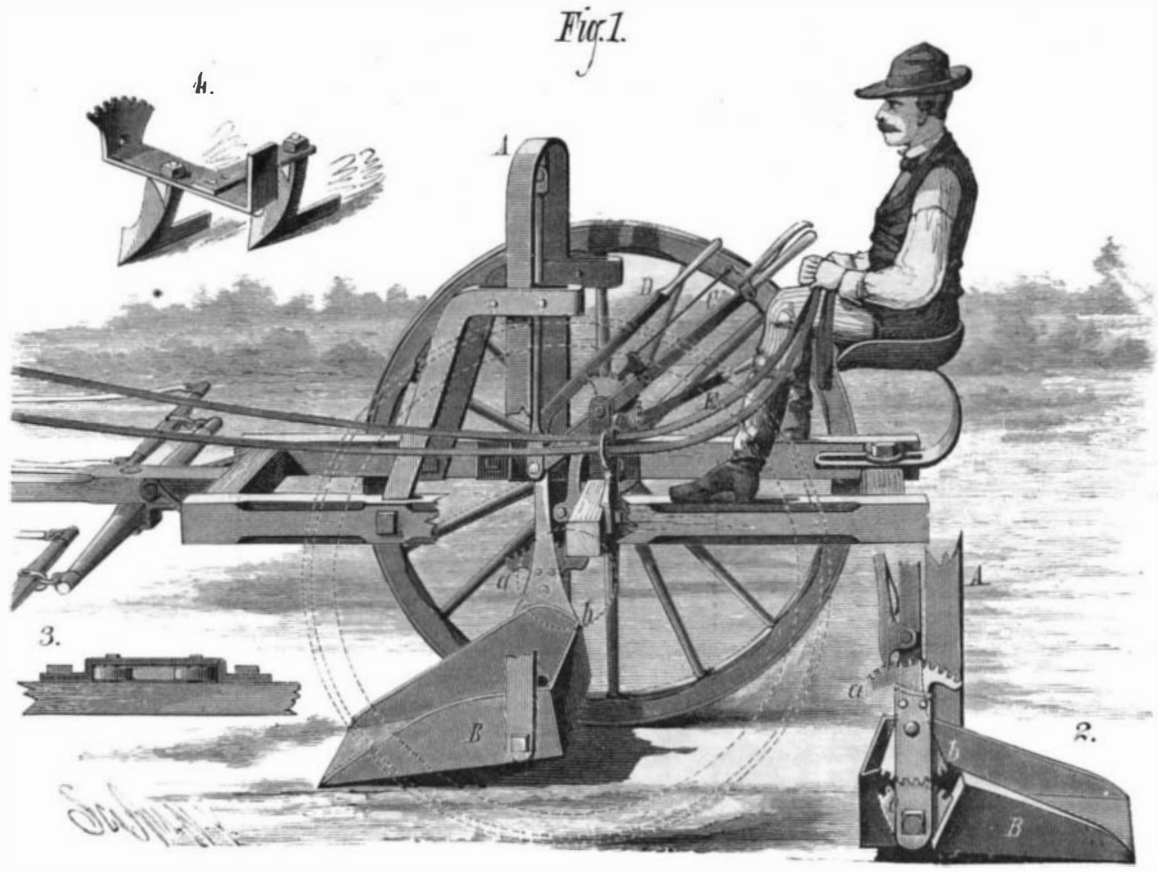
An improved device for testing milk by comparing its color with a scale of shades of colors, has been patented by Mr. Friedrich Heeren, of Hanover, Germany.

An improved last, for the manufacture of boots and shoes, has been patented by Messrs. John Martin and Josiah Merrill, of Great Falls, N. H. It can be changed to suit the style at a small cost.

NEW ROAD SCRAPER.

We give herewith an engraving of an improved road scraper for moving dirt from one locality to another and for leveling and grading. It is mounted on wheels and is provided with levers, by means of which every movement of the machine may be readily controlled by the driver, who sits on the seat at the rear of the main frame.

Fig. 1.



AGEE'S ROAD SCRAPER.

For the sake of showing the working parts of the machine one of the supporting wheels is removed, and parts of the framing are broken away.

A forked frame, A, is guided in roller bearings in the main frame and in the braces extending upward from the frame, and has pivoted between its lower ends the scraper, B, which is made either wholly or in part of iron or steel. A lever, C, is fulcrumed on a standard attached to the axle, and is connected with the upper part of the forked frame, A, by means of a connecting rod, so that the support may be moved up or forced downward as occasion may require. The lever, C, is provided with a pawl which drops into a toothed sector attached to the lever support, and holds the frame, A, at any desired height.

A toothed sector, *c*, is secured to the side of the scraper, and is engaged by another toothed sector, *b*, pivoted to the frame, A, and extended upward and backward, forming the lever, D, and the latter carries a toothed sector, *a*, which is engaged by a pawl pivoted to the side of the frame, A, and extended upward and rearward, terminating in the handle. This pawl locks the scraper securely at any desired angle that is in position to scrape up the earth, or with the edge elevated in position to retain the earth. It will be seen that with mechanism thus arranged the driver