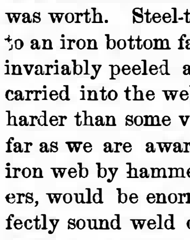
CAST-WELDING OF STEEL AND IRON--A NEW COMBINATION RAIL.

Not a few important improvements in the art of construction have been effected by using old principles in a new way; and it does not appear that those who thus divert the ideas of others into novel channels, deserve less credit than more original inventors. Success is, after all, the popular test of inventive skill; and as an invention fails or succeeds, so will the voice of public opinion award praise and wealth on the one hand, or oblivion on the other, to the producer. A short time since an apparently novel, and certainly ingenious application of an old principle to a new purpose was brought under our notice in Sheffield. Whether the idea involved is or is not absolutely new, we shall not pretend to decide. Certain it is, that if as successful as it promises to be, the invention will effect a considerable advance in the manufacture of rails, and therefore we have no hesitation in bringing it prominently before our readers.

For very many years attempts have been made, from time to time, to produce a rail which shall have a hard table and a comparatively soft and ductile web and foot; such a condition would obviously best be complied with by a rail, the table of which would be of hard steel, while the web and foot would be of iron. Nearly all these attempts have resulted in failure. Dodd's rails, the upper tables of which were converted by a species of cementing or case-hardening process, have not become popular; either because the process of converting was uncertain in its results, or the cost was greater than the result was worth. Steel-topped rails, made by welding the steel top to an iron bottom failed, because, under heavy work, the steel invariably peeled away from the iron, unless the weld were carried into the web; and even then only puddled steel, little harder than some varieties of iron, could be used. No one, so far as we are aware, has attempted to weld cast steel to an iron web by hammering or rolling. The cost, including wasters, would be enormous, and the difficulty of securing a perfectly sound weld over miles of bars insuperable. It follows that rails, as now made and generally used, are all iron or all steel, or of the compound type used by Mr. Ashcroft on the Charing Cross line, in which a steel top and web are secured between wrought iron angle flitches by cross bolts. We have recently examined rails with cast steel tops made at Sheffield by, as we have said, a new application of an old process, which bid fair to solve a difficult problem. Too few of these rails have been made to enable us to pronounce the process a complete success; but bearing in mind the very imperfect nature of the experimental appliances by which they were produced, the results have been very satisfactory; and as new furnaces and plant are being put down to test the principle thoroughly, we shall soon be in a position to pronounce a positive verdict on the subject, one way or the other.

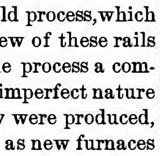
The process of manufacture is excessively simple and may be explained in a very few words. An immense number of cutting blades, for shearing iron, slicing tobacco, carpenters' planes and chisels, wood-turning tools, etc., are made every year in Sheffield, in which a very moderate quantity of cast steel, of the best quality, is secured to anything rather than a moderate quantity of, it may be indifferent, iron. Popularly, it is thought that the steel is united to the iron by welding under the hammer; but this is contrary to fact. The cost would be too great, and the weld might or might not be good. A far more elegant system is adopted. Let us suppose that a heavy steeling for a pair of shears is required. In producing this, an ordinary steel ingot mold is taken, and set up on end in the casting house. The mold is made of iron, rectangular



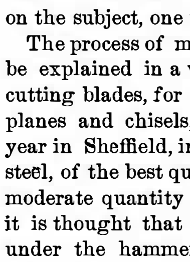
in section, and in halves, secured together by bands and keys. For convenience, we give here a plan of the mold, looking down it from the top.

A pile of scrap iron is heated and forged under the hammer. Its weight may be anything, from 30 lb. or 40 lb. to 2 cwt. or 3 cwt., and in section its shape is shown in the cut next below.

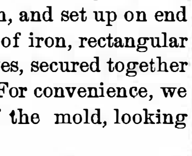
This pile or bloom is about the same length as the mold. A short time before the steel pots are ready to be drawn, the pile is heated, in a proper furnace, to a bright red heat. It is then brought quickly to the casting house and placed in the mold. The whole, then, is in cross section, as in the third cut. Melted cast steel, in proper quantity, is then poured



into the vacant space, and the result is that the steel unites so



soundly to the iron, the surface of which it partially fuses, that it is difficult to tell, on making a cross section, where the iron begins and the steel leaves off, to the one sixteenth of an inch. The ingot may then be reheated and worked into any required form by rolling or hammering, the steel always reducing in a given ratio with the iron. We have seen combination ingots, consisting of some 4 cwt. of iron and 1 cwt. of steel, thus made with perfect success. This is the principle which has been applied by Mr. E. Gray, of the Moscow Works, Sheffield, to the manufacture of steel-topped rails. He places within an ingot mold, of the required size, a heated pile of iron, A, and he fills up the vacant space, B, with fluid cast steel. From personal inspection of numerous



samples, we have ascertained that the union of the two metals is perfect. No subsequent rolling or hammering will separate them.

In converting this ingot into a rail, it is passed through rolls in the usual way, but care must be taken to drive the mill as though it were working altogether on steel. If the pile is highly heated, and the rolls are run quickly, the steel will behave precisely as cast steel always behaves under such conditions; it cracks and splits, and breaks up along the edge of the table. If the pile is moderately heated, and the rolls run slowly, and with an easy draft, the steel works perfectly, and a rail results, which, judging from inspection, leaves nothing to be desired. We need hardly add that, should the process be as successful as the inventor—in our opinion reasonably—believes, a rail will shortly be introduced to the public which will be superior to any other now in the market, possessing, as it will, that combination of hardness and toughness most desirable and most difficult of attainment. The process, it will be seen, was applied to other purposes than the manufacture of rails nearly thirty years back. It is, of course, possible that difficulties may arise, which even the practical steel worker—and Mr. Gray has been working steel all his life—cannot foresee, which will defeat the success of his process. But it is not easy to understand in what they will consist, and we are, upon the whole, justified, we think, in regarding Mr. Gray's invention as one full of promise, and likely to lead to very important results.—*The Engineer.*

PROGRESS OF THE VELOCIPEDE.

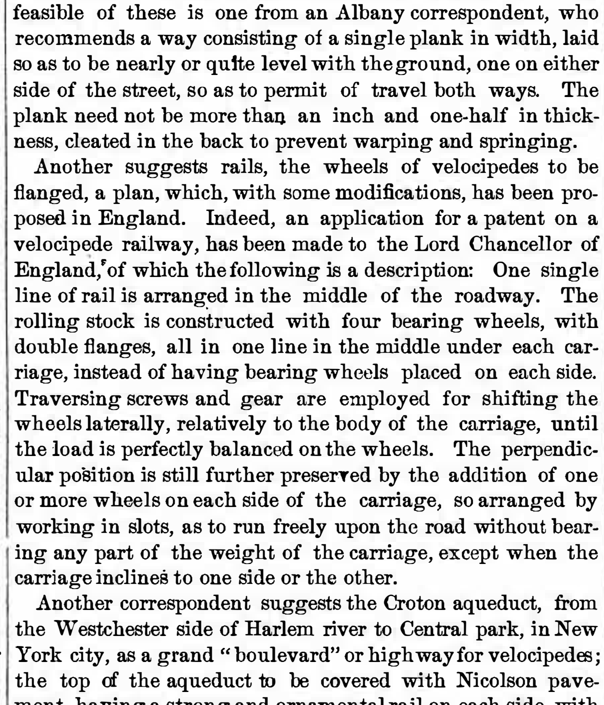
We are in receipt of several communications relative to the construction of roadways for velocipedes. Among the most feasible of these is one from an Albany correspondent, who recommends a way consisting of a single plank in width, laid so as to be nearly or quite level with the ground, one on either side of the street, so as to permit of travel both ways. The plank need not be more than an inch and one-half in thickness, cleated in the back to prevent warping and springing.

Another suggests rails, the wheels of velocipedes to be flanged, a plan, which, with some modifications, has been proposed in England. Indeed, an application for a patent on a velocipede railway, has been made to the Lord Chancellor of England, of which the following is a description: One single line of rail is arranged in the middle of the roadway. The rolling stock is constructed with four bearing wheels, with double flanges, all in one line in the middle under each carriage, instead of having bearing wheels placed on each side. Traversing screws and gear are employed for shifting the wheels laterally, relatively to the body of the carriage, until the load is perfectly balanced on the wheels. The perpendicular position is still further preserved by the addition of one or more wheels on each side of the carriage, so arranged by working in slots, as to run freely upon the road without bearing any part of the weight of the carriage, except when the carriage inclines to one side or the other.

Another correspondent suggests the Croton aqueduct, from the Westchester side of Harlem river to Central park, in New York city, as a grand "boulevard" or highway for velocipedes; the top of the aqueduct to be covered with Nicolson pavement, having a strong and ornamental rail on each side, with a low central rail to divide the up and down travel.

We regret that, delightful as would be such a velocipedal Utopia, the expense connected with the scheme compels us to pronounce it impracticable.

We give herewith an engraving of a water velocipede, devised by a Boston inventor, which is a very neat device. It needs no detailed description, as its operation will be readily comprehended from the engraving. The rudder is worked



by two cords passing from the steering bar, over pulleys fixed upon the side of the boat below and in front of the operator, and from thence back to the tiller.

The Hamilton county *Evening Times* has an account of a velocipede which it says "may be classed in the genus *Velocipedus giganticus*, is fashioned with three wheels, two large ones, of over six feet in diameter, and one small wheel forward, working on a pivot, by which the establishment will be guided. The locomotive power is communicated to the axle of the large wheels, by means of four treadles, two persons being required to drive the machine at full force, who are comfortably seated in an ordinary carriage-seat over the axle. A third passenger may be accommodated on a forward seat, and manage the steering apparatus, or either such assistance may be dispensed with. An ingenious arrangement is attached to the axle, by which the treadle power can be thrown off when descending declining ground, and the establishment be allowed to run by its own momentum.

It thinks that gigantic velocipedes may be immediately constructed on this principle, with wheels from twenty-five to thirty feet in diameter, to supersede those old-fashioned abominations, the ordinary stage coaches, and to be propelled by the passengers themselves.

The number of velocipede halls in New York and Brooklyn is now about thirty, and "still they come." Most of them are schools of instruction, where, for a moderate fee, the most awkward individual in existence, can be taught the management of the erratic, but not untamable, iron steed.

An important fact was elicited at a recent display of velocipede riding on Clinton street, Brooklyn, and that is, that the large wheeled velocipedes ride easier and go faster than the small wheeled machines, even when the latter are ridden by the best riders. Another important fact, developed by the experiment, is, that an effective brake on the hind wheel is positively necessary. We have not yet seen a brake which had enough iron to cover the tire of the wheel with. All those now in use scarcely have an inch of iron surface to bear on the wheel, when four times the amount would not be too much. The leather thongs, too, connecting the brakes with the guiding arms, should be replaced by the wire cord, as it is absolutely necessary that the brake cord should be made of material that will not give way.

A slight grade affects the progress of the small-wheeled velocipedes considerably, an effort being required to propel a machine from Atlantic street to Montague, while, on the other hand, a man can start from Montague street to Atlantic, and go all the way without using the treadles or putting his feet to the ground. The rule is, that the larger the wheel the easier a grade is ascended. It was decided by a unanimous vote that good spring seats were requisite on the Nicolson pavement.

A noteworthy feature of the display was the fact that not a solitary horse shied at the velocipedes, much to the disgust of the old fogies, who had prophesied that bicycles would lead to endless accidents from frightening horses in the street.

As some physician of this city has been publishing a sensation statement about certain injurious effects likely to occur from the use of the velocipede, the following from a leading practitioner may serve to counteract any fears that may have been created in the minds of the timid. He says: "I look upon this mode of exercise with this physiologically constructed machine, as one of the most brilliant discoveries of the nineteenth century; the grand desideratum that will emancipate our youth from muscular lethargy and atrophy that are so common."

The *Ironmonger*, an able London periodical, thus speaks of the utility of the velocipede: "Recognizing, as we do, in the velocipede a positive addition to the locomotive powers of man, we feel justified in again recurring to the subject, more particularly with the view of placing our readers *en courant* with what is being done to meet present requirements. Since our last issue new evidences have been presented, that, although England has been slow to follow the movement in France and the United States, a general demand is springing up, so much so, indeed, that our velocipede manufacturers experience already the greatest difficulty in supplying orders. We hear of Sheffield and Birmingham houses being engaged to fulfill the orders of London manufacturers, while velocipedes are being daily imported from France. Already West-end and City clubs are forming; and if there is no intention, as in France, of seating professors of the noble art of 'velocipeding' in the chairs of colleges, there is every prospect that large training schools will shortly be opened. Nor is this remarkable; the velocipede is already recommended by convenience, utility, and economy."

To this may be appropriately added the statement of the *Velocipedist*, for March: "The shipment of velocipedes from this country to England has commenced; the Inman steamer of Saturday last took a 'Pickering' machine, which is to be followed by others as soon as completed."

We have received the following communication:

MESSRS. EDITORS:—There is to be erected here a large rink, and the committee desire to be informed where rubber tire can be procured and put on to velocipedes. If you will be kind enough to refer us to some one who can do it, you will very greatly oblige a subscriber to, and an admirer of the SCIENTIFIC AMERICAN. GEO. A. COLES.

Middletown, Conn.

Having referred this communication to a prominent rubber manufacturer, we were informed that he knew of no place where these tires could be obtained. Every velocipede manufacturer in the country is trying to get this done, but none of them have as yet succeeded. It is a difficult job to do.

A Silk Community in California.

The latest and most novel idea in the silk culture is Mr. D. F. Hall's embryo "silk community." According to the Los Angeles *Star*, Mr. Hall has bought a large tract of land, forming part of the San Jose Ranch, about thirty-two miles east of Los Angeles. He proposes to lay off the entire tract, which is two miles and a quarter one way, by one and a quarter the other, into blocks and streets of suitable dimensions, for the convenience of the residents, and offer it for sale to actual settlers. The blocks will be forty acres in size, to be subdivided into lots of from one to ten in size. Ten-acre lots will only be sold to those who will make improvements thereon.

"There are certain benefits to be derived from a settlement of this kind, entering upon and making a specialty of the silk culture, that will particularly commend themselves to those wishing to enter the business, and particularly immigrants from the densely populated countries of Europe. For an extensive cocoonery, but a comparatively small quantity of land is required, as it is computed that seventy-eight tuns of mulberry leaves will produce one million cocoons, and that three acres planted in mulberries will yield ninety tuns of leaves. Upon this basis a ten-acre lot will be ample for producing three millions of cocoons, leaving sufficient spare grounds for buildings, fruit, and flowers, without which, no place is fit to be called home. By this small subdividing, the community will have all the enjoyment of suburban life, with the benefits of churches, schools, lyceums, libraries, etc., etc., all of which are the necessary adjuncts to an enlightened, prosperous, and happy community."

Correspondence.

The Editors are not responsible for the Opinions expressed by their Correspondents.

Power of the Crank.

MESSRS. EDITORS:—Your correspondent, J. W. H., on page 151, current volume, asks some questions in relation to the effective force of steam, at a given pressure, when applied at different points on the crank.

These are no new questions. Almost every mechanical student, at some point in his investigations, takes a tilt at the crank. When this attack is made with courage, and pursued with sufficient energy to really test the mettle, and bring out the qualities of this cranky old veteran, the valiant student surrenders, and embraces the ugly monster—the abrupt angles become lines of beauty, and no amount of argument or urging can induce him ever again to renew the attack.

I have thought that much of the mystery which envelops the movement of the crank, is thrown around it by the foggy explanations often given by our teachers. We are told of the "leverage" of the crank. We are lectured about levers of the "first power" and of the "second power," of "third and fourth powers." All such numerical terms applied to the levers and to the crank, tend to mystify rather than to elucidate the principles of their operation.

As a mechanical device, the crank is governed by the great laws that underlie and govern all mechanical devices. In transmitting motion, or power, it communicates just what it receives—no more, no less. It does this equally and exactly at all points, as well when in a line with the reciprocating mover, or when at right angles to it. To comprehend this truth, we need no harangues about the numerical powers of levers, but we must understand that to constitute a power, that is, force producing motion, two elements or conditions are requisite: First, an inclination to move; and secondly, space, or distance through which to move. The sum of these two conditions, is the measure of the power. Neither the one nor the other condition, alone, can exert any effective force.

In the steam engine, we have, as the first element of power, the pressure of steam in cylinder. This pressure is a tendency to move in all directions; but while it is held motionless behind the unmoved piston, it is mere statical pressure, and is no more a power than the cohesive strength of the iron that holds it is a power. When the piston moves, then the pressure becomes dynamical, and we have a power. Then if, as J. W. H. suggests, the pressure is 4,000 lbs., and the distance moved two feet, we have 8,000 foot-pounds; but if the distance moved is but one inch, the power is $4{,}000 \div 12 = 333\frac{1}{3}$ foot-pounds. And it must be carefully borne in mind that this is not only the measure of the power given off by the crank, but that it is also the exact measure of the power exerted by the steam.

I have said that the crank gives off at all points, the whole power that it receives. Of course the whole is not given off as effective work. Like all other devices, the crank must pay a tax to friction, and whether that tax is more or less on the crank than on other movements, is not what I propose now to consider. But the working of the crank, apart from friction, is the question.

J. W. H. complains that the crank gives no power "at either of the dead centers." Does it receive any at the dead point? While the piston stands still, does it cost anything? If, then, no power is expended on the crank at these points, none should be expected from it. But let us consider, for a moment, what is the effect when the piston moves forward.

We will take the engine as J. W. H. proposes, 24-in. stroke, 50 inches of piston area, with 4,000 lbs. pressure. When this piston has advanced one inch, the crank pin has passed nearly five inches, and has reached a point where the 4,000 lbs. on the piston will amount to 1,500 lbs. on the wrist. Now, if we carefully compute the pressure upon each inch of this arc, we will find their sums to make 4,000 lbs. raised one inch, or $333\frac{1}{3}$ foot-pounds. While the piston is moving the second inch, the crank moves about two inches; but a computation of the pressure on these two inches, will gives us $333\frac{1}{3}$ foot-pounds as before. Near the point of half-stroke, the piston and crank pin move in nearly the same line, and the pressure upon them is about equal; but here, while the piston travels one inch, the crank travels but one inch also, and as it has here but the 4,000 lbs. pressure and one inch travel, it gives still but $333\frac{1}{3}$ foot-pounds. We might follow this, inch by inch, through the whole stroke, and show that wherever the pressure is nearest to the line of travel of the crank, the movement of the wrist is least, and where the pressure is most indirect, the motion of the crank is greatest, so as to make the pressure and distance together, exactly equal at all points. The pressure on the piston being constant and equal to 4,000 lbs. per each inch moved, while that on the crank varies as the line of motion varies from that of the piston; but the distance traveled by the piston is everywhere just as much less than that of the crank as the pressure on it is greater.

Now if J. W. H. will take the distance traveled into the calculation, he will obtain the solution to his problem. He asks, "What number of inches of piston area will equal the above (the fifty inches as just considered) if applied six-sevenths of the entire circle, under same pressure of steam and same leverage of crank." About 37·5 inches of area would be equal in pressure to the fifty on the crank, but the travel, to make six-sevenths of a 24-inch circle, would be, in round numbers, 64 inches. With his arrangement, J. W. H. will have 37·5 inches area and 64 inches length; hence, will use $37{\cdot}5 \times 64 = 2{,}400$ inches of steam per revolution. With the crank, the travel of piston is 48, and the area 50 inches. Hence, $48 \times 50 = 2{,}400$ inches—exactly the same in both cases.

However much the friction may be lessened, or the motion regulated by applying the power regularly in the line rotation, it is clear that, apart from these, no power can be gained.

Keokuk, Iowa E. S. WICKLIN.

The Dynamic Lever.

MESSRS. EDITORS:—The "Dynamic Lever" man, who furnished the article at page 165 of your last number, signed F. R. P., has a kink in his brain which needs to be straightened out only for the purpose of saving him from wasting his thoughts upon a fruitless inquiry, but your columns from being further occupied with it.

He says, referring to the diagram which accompanies his article, there is a force of 70 lbs. at C in the direction of the motion of the boat, and that this force will propel the boat against a resistance of 70 lbs. Now, if this were true, under the circumstances, which he defines, we should have no further use for balloons and flying machines, since every man could at his pleasure, lift himself into the air by the waistband of his pantaloons.

As in celestial mechanics, the mutual actions and reactions of the bodies of a system have no effect upon the motion of the center of gravity of the system; so in terrestrial mechanics the mutual action and reaction between the connected parts of a structure have no effect to move the structure.

F. R. P. overlooks the fact that while there is a forward force of 70 lbs. at C, there is an equal and opposite reaction at the same point, and that these equal and opposite forces being both received upon the connected parts of the same structure neutralize each other, just as the upward draft upon the waistband of the pantaloons is neutralized by the down ward draft upon the hands. The point, C, is not the place where we are to find the force that propels the structure, but the point, B, where one of the equal and opposite forces is received upon matter which forms no part of the connected structure. There the force is 10 lbs., and it is capable of moving the boat against a resistance of 10 lbs. only.

These considerations, which are so simple and obvious that it would seem they could hardly need to have been presented, cover all cases of "dynamic levers" whether found in animals or elsewhere. B.

New Haven.

Manufacture of Glass by Rolling.

MESSRS. EDITORS:—I notice an article by Mr. C. Boynton, in your number for March 13th, under the head of "Window Glass," in which he asks "Why a pot of glass cannot be drawn out into sheets, as well as a continuous sheet of paper? and also asks, "Who is there that has capital, and spunk enough to try the experiment?"

In reply I would say that about twenty years ago Messrs. Chance Bros. & Co., of Birmingham, England (the largest window glass manufactures in the world), erected extensive works in London, for experiments in passing molten glass through two rollers (a patent for which had been obtained by Mr. Bessemer). After trying everything that ingenuity and skill could conceive of, it was found impracticable. Probably as much as £100,000 was expended in carrying on these experiments. The object of these trials was to make sheets of glass free from the undulations which are always presnt on the surface of blown window glass. Even had they been successful in rolling out the sheets, nothing would have been gained, as the surface of the glass would have been almost—if not quite—as undulating as the blown glass. This is apparent to any one who has seen the casting of plate glass, or to any one who will examine the smooth surface of a sheet of rough plate glass. The smooth side is the one over which the roller had passed, and which presents a very uneven surface. Did it pass between two rollers, of course both sides would be the same. To overcome the great defect in window glass, viz., the undulating surface, Mr. James T. Chance, one of the above named firm, invented ingenious machines for grinding and polishing such thin glass, after which process it is equal in effect to the expensive plate glass.

I believe it to be an impossibility to make sheets by passing the smelted glass between two rollers, and any one practically acquainted with the manufacture of glass, would, I have no doubt, agree with me.

Many reasons might be given showing its impractibility, were it worth while to mention them. I trust after reading this statement, Mr. Boynton may not think that it "seems to him to be a disgrace to American inventive genius that they have not accomplished that which is impracticable."

GEO. F. NEALE.

Lenox Furnace, Mass.

A Problem for Inventors---Plow Wanted.

MESSRS. EDITORS:—Possibly some of your readers—inventors—could invent or adapt a "breaking and turning plow" for our tough, heavy, and adhesive black and red lands, which—in consequence of the treatment they annually receive—require every spring to be as thoroughly "broken up," as they were when first reduced to cultivation. The treatment referred to, is that of pasturing all kinds of stock upon them after the crops are gathered, and during the winter, for scarcely any one, however practical, can refuse his stock the benefits of the luxuriant pastures which succeed our crops. Hence, they become greatly consolidated and indurated, requiring "re-breaking" every spring, and also, with the species of plows used, a much greater amount of horse or ox power than would be needed, were our plows exactly adapted to the work. As illustrative of the resistance these compacted soils present to the plows used, may be mentioned the fact that it requires four yoke of oxen to draw a Satlee gang plow of two plows. Yet these same lands, when properly broken up and submitted to the action of rain and sunshine, become so loose and mellow, or friable, as to be worked very easily the remainder of the season. All of the plows adapted to your light loamy lands present too much resistance in "breaking up" our heavy ones. They are too short and bluff up too much, and we are compelled to have manufactured locally, at much greater cost, a long plow with a wooden mold board, called a a "carey;" but this plow, better for the purpose than those imported from Northern manufactories, does not come up to the kind needed. The inventor should come and see the land in the condition it is when being broken up in the spring, in order to form a correct idea of the plow needed. It may be stated, that the plow that our heavy soils require, should be long, going into the land like a wedge, to which the resistance would be gradual and be distributed along the entire line of surface. Such a one as some agricultural writer describes as being used in the heavy stiff clay soils of Scotland. Some or the "carey" plows mentioned do fit the want, but as they are made, each one to the fancy or taste of the various makers, there is no certainty of the plow proving what is wished—so a cast or molded plow is needed.

A plow of the kind indicated, would, I am persuaded, upon due exertion and demonstration before our farmers, come into general use, and insure to to the inventor large demand and profits.

I am secretary (corresponding secretary) of the Montgomery county (Texas), Agricultural Society, and am authorized to write, etc., in its name, and so take the liberty of addressing you this letter. C. B. STEWART,

Cor. Sec. Agricultural Society.

Montgomery county, Texas.

Transmission of Power---An Ingenious Device.

MESSRS. EDITORS:—I have given the subject of compressed air much study and attention for the past few years, and have made some practical applications, hence, I watch with much interest the progress made by others in its application to various useful purposes. I saw a few days since a very ingenious application of compressed air as a means of transmitting power to the point where it was to be used, and, at the same time, admitting of a motion perfectly free in any direction. The device alluded to was operated by a dentist of this place. It was a rotary engine on a very small scale. The compressed air to propel the engine was furnished by a small foot bellows, which was double-acting, being two common bellows joined together. It was twelve inches long, by seven wide, and two and one-half inches high, and was operated by the dentist without inconvenience. The engine was run at a very high rate of speed, which I have since seen tested, and also the power. The speed attained, when running, at about the usual rate, was four thousand per minute, by actual count, by means of two pairs of watch wheels, which reduced the motion sixty times. It raised a weight of one and one-half pounds over a pulley of one-fourth of an inch in diameter on the engine shaft. The air was conducted to the engine through a one-fourth inch rubber tube. It was evident that the friction of this little instrument must be very small, else the power would have been absorbed at that very high motion. The instrument was used to rotate small burrs to dress out and undercut the cavities in teeth before filling them, and to dress off the foil after filling. It also had a reciprocatory attachment for operating a small saw or file to cut between the teeth. The same motion was used for polishing. The engine formed a part of the instrument, and the whole together weighed but eight and one-half ounces. The dentist claimed that he could accomplish as much, by the use of this instrument in two minutes' time, as would have taken him one hour in the ordinary way. The applications are very numerous where this mode of transmitting power can be used with equal advantage and that too without the use of any gearing or belts to produce the motion desired. There are some other points which occur in the application of air to mechanical purposes to which I would like to call the attention of practical men. One is the construction of valves in the various pneumatic instruments. The principles which govern their operation do not appear to be generally understood. The same is also applicable to steam or gas under similar circumstances. The valves to blacksmiths' bellows are quite often at fault. I have known instances where the power required to operate the bellows of the same dimensions would vary one hundred per cent simply from the difference in the construction of the valves. A good illustration of the principles governing their operation may be had in the following experiment: Take a piece of board planed smooth on on one side, and bore a hole through it of suitable size to receive the end of a piece of rubber tubing from the under side of the board, not so large but that you can blow a sharp blast of air through it. Then take a common business card, punch two holes through one end of it, place the center of the card over the hole in the board, and stick a pin through the holes in the card into the board to prevent the card from moving sidewise. Now take the other end of the tube in your mouth and blow strongly. It will be found impossible to raise the card from the board, no matter how good a blower the experimenter may be. If not satisfied with this, and it is desired to try a higher pressure, the tube may be attached to a steam boiler, using a piece of rubber packing in place of the