

It is employed in the strongest parts of engines as well as in the finest wheels and springs of a watch; in building the mighty iron-clads; in the bulky death-spreading cannon; in the most delicate surgical instrument! It shows its importance when we consider in what proportion its value is enhanced when fashioned into the weighty anchor, the finest fishing-hook, the plowshare, the mower's scythe, or the cambric needle. The values of the precious metals, on the other hand, when leaving the refiners' furnace, differ but little from those of the coined money. While, for instance, the most delicate watch spring is worth a million times more than an equal weight of the steel bar from which it was made, the value of the most elaborated gold or silver article is seldom double the value of the refined metal.

Various articles of daily use have been proposed as indexes of the wealth and civilization of nations. Statisticians and social economists, who have investigated this subject, have arrived at the conclusion that there is no product better adapted for this purpose than iron, and it may be truly held that nearly all branches of human activity are deriving direct or indirect benefit by an increased consumption of this metal.

I have constantly, for thirty years, given attention to the statistics on the diffusion of iron, and I give as follows the results of my investigations:

The yearly average consumption of iron per individual amounts in Great Britain to 100 lbs.; England alone, 150 lbs.; United States of North America, 90 lbs.; Belgium, 70 lbs.; France, 55 lbs.; the German Zollverein, 50 lbs.; Sweden and Norway, 25 lbs.; Switzerland, 22 lbs.; Austria, 20 lbs.; the German part of Austria, 45 lbs.; Italy, 15 lbs.; Russia, 11 lbs.; Spain and Portugal, 10 lbs.; the East Indies (population 180,000,000), 1 lb.

It may be mentioned yet with respect to this table, that England, Belgium, and Sweden appear in too favorable a light, on account of the circumstance that these countries are the only ones which produce larger quantities of iron than they consume themselves, and also because of the fact that the smelting of iron itself requires a comparatively considerable amount of this metal.

**Vegetable Electromotors.**

The *Chemical News* contains an article contributed by Edwin Smith, M. A., giving results of researches in a field which so far as we are aware has been hitherto untraversed. He says: It is well known that a voltaic combination may be made of two liquids and a metal, if one of the three acts chemically upon one and only one, of the other two; thus—we may employ copper, nitrate of copper and dilute nitric acid, or platinum, potash, and nitric acid. Connect a platinum crucible with one terminal of a galvanometer, pour in a little solution of caustic potash, place in this the bowl of a tobacco-pipe having the hole stopped up with wax, pour into the bowl a little nitric acid, dip in the acid a small slip of platinum foil, and connect this with the other terminal of the galvanometer; a powerful deflection of the needle indicates the presence of an electric current and shows its direction to be from the alkali to the acid, the platinum serving merely as a conductor. It occurred to me, when performing this experiment, that an electro-motive combination might just as well be made of two vegetable substances, with platinum for conductor, provided only they were of a nature to act chemically upon one another—an alkaloid and an organic acid, for instance. It also seemed to me not unlikely that, wherever two flavors are habitually conjoined in our cookery and eating, the reason why they mutually improve each other is because a certain amount of electric action is set up between the substances employed to produce them. The rationale of the right blending of flavors might be found partly, no doubt in chemistry, but partly, also in galvanism.

Pursuing this idea, I tried pairs of eatables which generally go together, such as pepper and salt, coffee and sugar, almonds and raisins, and the like, and found that a voltaic current more or less strong was excited in every instance which I tested. Bitters and sweets, pungents and salts, or bitters and acids, generally appear to furnish true voltaic couples, doubtless in consequence of the mutual action of some alkaloid salt and an acid or its equivalent. As others may like to repeat or extend the experiments, I will describe shortly my mode of procedure: Cut two pieces of platinum foil about 5 inches by 2½ inches, and a number of pieces of filter paper a trifle larger. Well-washed linen is sometimes more convenient than filter paper. Have a small wooden board near the mercury cups of the galvanometer, and let a short copper or platinum wire, dipping into one of the cups, rest on the board. The substances to be tried must be brought to a state of solution, the stronger the better, by infusion, decoction, or otherwise. Suppose coffee and sugar are to be operated upon; solutions of both having been prepared, dip into each a slip of filter paper; place one slip on one of the pieces of platinum foil, and the other on the second piece. Next lay the first slip and its foil on the board, with the metal touching the copper wire before mentioned. Lay the second slip with its platinum upwards, so that the coffee and sugar come into even contact with slight pressure, and immediately connect this upper slip, through a bit of copper wire, insulated from the touch, with the other terminal of the galvanometer. Deflection occurs instantaneously, and may be increased to a considerable vibration by breaking and making circuit at the right swing of the needle. After a few distinct vibrations, it is well to turn over the whole pile of slips just as they are, and connect opposite ends with the galvanometer, so as to reverse the current. This is desirable for the sake of confirming your previous observation, and of correcting any slight disturbing cause arising from the wire and mercury connectors, temperature of the hand, etc. It will be found that cof-

fee and sugar have the same electrical relation to each other as zinc and platinum. Coffee, in fact, is the positive, sugar the negative element. I subjoin a table of the results of numerous experiments, conducted in the manner above described:

| ELECTRO-POSITIVE.       | ELECTRO-NEGATIVE.      |
|-------------------------|------------------------|
| Coffee.....             | Sugar (loaf).          |
| Tea (black).....        | "                      |
| Cocoa.....              | "                      |
| Nutmeg.....             | "                      |
| Cloves.....             | "                      |
| Cinnamon.....           | "                      |
| Mace.....               | "                      |
| Vanilla.....            | "                      |
| Almonds.....            | "                      |
| Rhubarb(tincture).....  | "                      |
| Starch.....             | "                      |
| Starch caramel.....     | "                      |
| Gum caramel.....        | "                      |
| Cane sugar caramel..... | "                      |
| Milk sugar.....         | "                      |
| Gum.....                | "                      |
| Almonds.....            | Raisins                |
| Horseradish.....        | Beetroot               |
| Onion.....              | "                      |
| Horseradish.....        | Table salt.            |
| Mustard.....            | "                      |
| Pepper (white).....     | "                      |
| Mustard.....            | Tartaric Acid.         |
| Ginger.....             | "                      |
| Cayenne pepper.....     | "                      |
| Pepper (white).....     | "                      |
| Tea (black).....        | "                      |
| Tobacco.....            | "                      |
| Quinine (Howard's)..... | "                      |
| Gentian root.....       | "                      |
| Lemon juice.....        | "                      |
| Horehound.....          | "                      |
| Lavender water.....     | "                      |
| Quassia.....            | "                      |
| Peppermint.....         | "                      |
| Raw potato.....         | Lemon juice.           |
| Rind of Lemon.....      | "                      |
| Peruvian bark.....      | "                      |
| Camphor (tincture)..... | "                      |
| Laudanum.....           | "                      |
| Arnica (tincture).....  | Dilute Sulphuric Acid. |
| Peruvian bark.....      | "                      |
| Quinine (Howard's)..... | "                      |
| Iodine (tincture).....  | Turpentine.            |
| Caustic potash.....     | "                      |
| Starch.....             | "                      |
| Starch.....             | Iodine (tincture).     |
| Caustic potash.....     | Neat's-foot oil.       |

It is somewhat difficult to eliminate from these experiments all error arising from difference of temperature, if the galvanometer is tolerably sensitive. Care must be taken to bring the pair of solutions operated upon to the same temperature before testing them; otherwise a thermo-electric current from the hotter to the colder liquid may affect the needle, and mask the true electrical relation between the two, so far as it depends upon their chemical nature.

**ASTROLOGY AND ASTROLOGERS.**

To use the rather strong language of a cotemporary, there are still fools who are not only fools, but who seem willing, nay anxious, to spend money to prove themselves so. The advertising columns of the New York dailies contain the proof of this assertion, in the numerous advertisements of fortune tellers, clear-sighted physicians, and astrologers. A very little investigation will convince the incredulous that not only do these imposters make money, but some of them make a good deal of it, by playing upon the credulity of the ignorant and superstitious. The belief that these pretenders have the power to foretell events is not confined to the totally uneducated. Will it be believed, that a lady educated sufficiently to occupy with credit the position of principal of a department in one of our city public schools, did on a recent occasion consult one of these quacks in full faith as to his powers? We know this to be true, and are also possessed of information that clearly proves this superstition to be wide spread, extending even into the higher classes of society.

The following extracts from "Diecks on Astrology," will show the absurdity of putting any faith in these deceivers, if indeed, anything need be said in this enlightened age of the world upon such a topic.

"Astrology is merely a philosophism, being empirical, wholly visionary, a mere fanciful system compounded of incongruous mixtures of astronomical with human events, of mythology and theology, and of facts with pure fiction. It has been variously designated Judicial, Hororary, Atmospheric, and Mundane Astrology. It has also many offshoots subservient to magic or the black art, sorcery, witchcraft, and other pretended mysticisms, ostentatiously styled occult philosophy.

"We may first observe that astrology lays no claim to inspiration, but affects a very ancient unknown origin, tracing back to a dark, heathenish, and superstitious age, in the very infancy of traditional knowledge, when the boldest assertions of the seer [!] were received as the authority of an oracle, no one daring to question their validity. Whatever is remotely possible the astrologer accepts as a fact, while, ignorant of much around him, he assumes with the utmost complacency an intimate acquaintance with the sun and planets thousands upon thousands of miles off; the sun, 807,076 miles in diameter, while he himself inhabits a globe only 7,916 miles in diameter, from which the moon is 238,000 miles distant, and the sun 400 times that distance. The accompanying diagram shows the relative diameters of the planets.

And these immense bodies revolving millions of millions of miles away in immeasurable space, are described by him as fashioning an infant's nose, directing the fortunes or misfortunes of lovers, ordering the property of traders, meting out diseases, and improving or deranging men's mental faculties. And, as if such puerile influences were not sufficiently

preposterous, we are informed by the modern seer [!], Zadkiel, that the twelve signs of the Zodiac not only 'rule' the several parts of the human frame, but also those of a ship, as Aries, the bow; Taurus, the cutwater; Gemini, the rudder; Cancer, the bottom; Leo, the upper works; Virgo, the hold; Libra, parts above the water's edge; Scorpio, the seamen's berths; Sagittarius, the seamen; Capricornus, the ends of the



vessel; Aquarius, the captain; Pisces, the oars in galleys, the wheels in steam vessels, and the sails in others; but these latter, being above water, we are left in doubt about the ruler of the submerged screw propeller.

"To show what a modicum of learning, and how trifling an acquaintance with matters of natural philosophy will serve the astrologer, we will turn to a modern treatise published in the year 1801, by Francis Barrett (styling himself a student of natural and occult philosophy), a quarto volume of upwards of 370 pages, entitled 'The Magus, or Celestial Intelligencer,' which affords a pretty clear insight into the nature of superstitions which, from an ancient period even to that date, obtained credence, and were popular with the multitude. Treating of the wonders of natural magic, previous to entering on the main topic of his treatise, he adduces a few of what he conceives to be ordinary matters of fact, assuring us that—'if any one shall, with an entire new knife, cut asunder a lemon, using words expressive of hatred, contumely, or dislike, against any individual, the absent party, though at an unlimited distance, feels a certain inexpressible and cutting anguish of the heart, together with a cold chilliness, and failure throughout the body; likewise of living animals. If a live pigeon be cut through the heart, it causes the heart of the party intended to be affected with a sudden failure; likewise fear is induced by suspending the magical image of a man [whatever that may be] by a single thread; also, death and destruction by means similar to these; and all these from a fatal and magical sympathy.

"The loadstone, he observes, possesses an eminent medical faculty against many violent and implacable disorders; the back of the loadstone, as it repulses iron also removes gout, swellings, rheum, etc., that is of the nature or quality of iron. Likewise the wearing of the loadstone eases and prevents the cramp and such like disorders and pains.

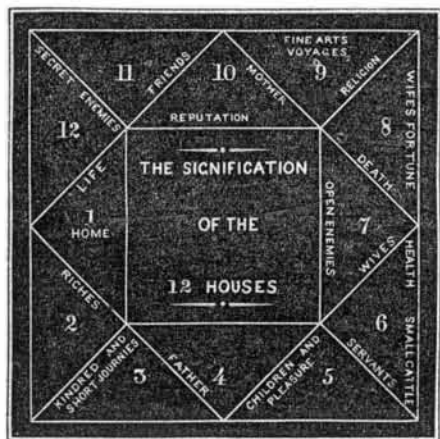
"The influences of the stars appear to be as intimately known to astrologers as though they had walked among and carefully examined and fully realized their occult properties; for example: In every work observe Mercury, for he is a messenger between the higher gods and the infernal gods; when he goes to the good he increases their goodness; when to the bad, he hath influence on their wickedness. It is an unfortunate sign or planet, when it is by the aspect of Saturn or Mars especially, opposite or quadrant, for these are the aspects of enmity; but a conjunction a trine, and a sextile aspect, are of friendship; but yet, if you do already behold it through a trine, and the planet be received, it is accounted as already conjoined. Now, all planets are afraid [!] of the conjunction of the sun, rejoicing in the trine and sextile aspect thereof.

"They say of the sun and moon; the sun is the lord of all elementary virtues; it disposes [Qy. 'of'] even the very spirit and mind of man. The moon, says Barrett, measures the whole space of the zodiac in the time of twenty-eight days; hence it is that the wise men of the Indians, and most of the ancient astrologers, have granted twenty-eight mansions to the moon, which being fixed in the eighth sphere, do enjoy divers names and properties, from the various signs and stars which are contained in them; through which, while the moon wanders, it obtains many other powers and virtues; but every one of these mansions, according to the opinion of Abraham [? reference], contained 12 degrees, 51 minutes, and also 26 seconds. In the first quarter of these mansions, the first conduces to discords and journeys; the second to the finding [? the hiding also] of treasures, and to the retaining of captives [Zadkiel ought to have been consulted by the Abyssinian Expedition]; the third, to benefit sailors, huntsmen, and alchemists; the fourth, to the destruction and hindrances of buildings, fountains, mills, gold mines, the flight of creeping things, and begets discord; the fifth, to help the return from a journey, the instruction of scholars, and confirms edifices, gives good health and good will; the sixth to hunting and besieging towns and revenge of princes, destroying harvests and fruits, and hinders the operation of the physician; the seventh, to confirm gain and friendship, is profitable to lovers, and destroys magistracies. In a similar manner the remaining three quarters have the characters of their general mansions allotted to them with equal exactness, and, of course, indisputable veracity also.

"We have here a fair example of the arrogant assumptions of ancient and indeed of all astrologers, magicians, and sorcerers—men who are incompetent to elucidate the ordinary phenomena of nature in the animal or vegetable creation, and yet with unbounded effrontery, affect to build up an empirical system, delivered in a language of their own invention, a pompous parade of jargon made up of the most incomprehensible materials, which, if wholly due to antiquity, partakes of ancient simplicity, credulity, deceit, and superstition; and if somewhat polished and refined to suit the advances of literature and science, has never been able to prove the correctness of its groundwork, or afford a solitary instance of its possessing any meritorious quality beneficial to mankind; while, on

the other hand, its evil consequences have been many, by destroying the peace and happiness of thousands, encouraging deceit, and misapplying in its ignoble pursuit the time and labor and property of its ardent but deluded admirers.

"In Judicial Astrology it is not thought requisite to consider more than a certain number of the planets after a method simplified by ancient astronomers, which is found to be so compact and so complete in governing the destinies of the human race, that modern intelligence has failed to enlarge the field of heavenly influences. Varley notes that the ancients discovered that the circle of the Zodiac, about 16 degrees in width, and through the middle of which runs the Ecliptic, or sun's path through the twelve signs, contains the heavenly bodies, named planets, and the principal fixed stars, and nearly the whole of the material, or significators, from which predictions are obtained. He remarks that, in forming a horoscope this circle is divided into twelve equal parts, corresponding with the spaces containing twelve hours. These twelve divisions are called houses; and they always remain fixed, while the Zodiac, with the twelve signs and all the heavenly bodies belonging to it, are considered to be moving through them all every twenty-four hours. The 'lord' of the ascendant is the planet which rules the signs rising at birth. In drawing horoscopes it is usual to make the figure square instead of round—as below :



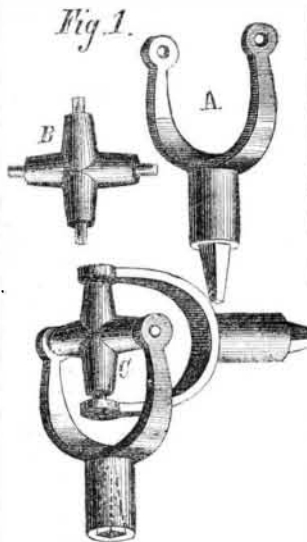
"The various significations arising from the aspects of the starry heavens at the time of birth are so exceedingly numerous, that we must refer the curious in such matters to the works themselves, in which all these pretended revelations are minutely recorded. Mankind rank astrologically as being of four temperaments: 1. One class is said to answer to the fiery trigon, also called diurnal, masculine, and choleric, consisting of Aries, Leo, and Sagittarius, which contains the spirited, generous, magnanimous, and princely natures. [Qy. Present example of princes]. 2. We have next the earthy trigon, being nocturnal, feminine, and melancholic, consisting of Taurus, Virgo, and Capricorn, containing the careful, sordid, and penurious qualities. 3. The aerial trigon, which is diurnal, masculine, and sanguine, consisting of Gemini, Libra, and Aquarius, contains the humane harmonies and courteous principles. And 4. The watery trigon, which is nocturnal, feminine, and phlegmatic; namely, Cancer, Scorpio, and Pisces, including the cold, prolific, cautious, and severe qualities. \* \* \* As affecting physiognomy we are assured that—the Scorpio noses are more acquiline than those of Aries, and are more frequently conspicuous for a sort of bracket-shape beneath, \* \* \* the mouth appears in the act of pronouncing the word 'severe.' When we meet in volume after volume with page after page of such composition as this, when we reflect on the sublimity of the heavens and the paltriness of such combinations as are here given of the planets with mundane affairs, we ask the reasons for arriving at such—and of course get a lot of balderdash. Zadkiel, in prefacing a work by Lilly, says: 'If a proposition of any nature be made to any individual, about the result of which he is anxious, and, therefore, uncertain whether to accede to it or not, let him but note the hour and minute when it was first made, and erect a figure of the heavens [see the figure], and his doubts will be instantly resolved. \* \* \* The works claiming to expound this pretended occult philosophy prescribe such childish processes that one naturally wonders how in the midst of so much impudent imposture, astrology and its kindred pursuits ever found or retained any honest partisans. Take for example the use of fumigations, such as of frankincense, etc., to Saturn; of cloves, etc., to Jupiter; of odoriferous woods to Mars; of all gums to the sun; of roses, violets, etc., to Venus; of cinnamon, etc., to Mercury; of the leaves of vegetables to the Moon; of all or any of which there must be a good perfume, odoriferous and precious, in good matters; but in evil ones quite the contrary. The Zodiac is also favorably affected by proper suffumigations. \* \* \* They affect to have suitable bonds by which spirits can be bound, invoked, or cast out. \* \* \* The exorcisms and conjurations of magicians are so audaciously profane and blasphemous as to be unworthy of even a passing notice."

SHAFTING, PULLEYS AND BELTS.  
No. III.

Our last article on the above subject, on page 264, left for consideration the balancing of pulleys, laying-out belt holes through floors, running belts at varying angles, and methods of hanging shafting.

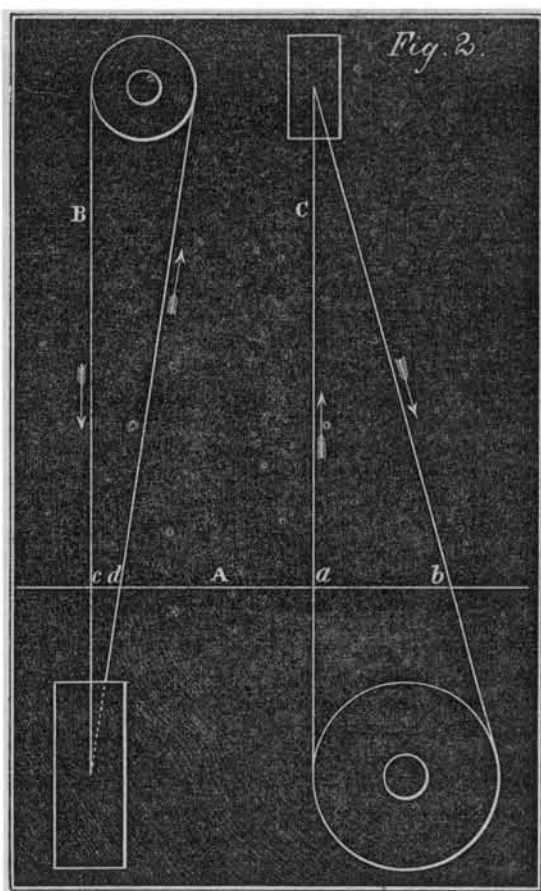
The building into which machinery is to be introduced should be constructed for that especial purpose. This is not always possible, many buildings erected for a different purpose being used for the reception of machinery. Still, it is far better that machinery should go into a building specially adapted

to its reception. The walls should be firm enough not to be affected by the jar inevitable in running machinery, the floors should be strong, and the spaces between the beams adapted, as nearly as may be, to the lengths of the sections of shafting, or to the points of support. The main shaft is better supported on a row of columns and running in bracket bearings. In this case the posts are braces connecting at least two floors and thus affording a much stiffer resistance to trembling. But, whether bracket or hanger, the boxes should be adjustable, in order to keep the shaft in line. There are numbers of improved hangers and boxes in the market that answer this requirement, but we shall not designate any one as superior to others. If it should be required to place a hanger between flooring beams, the floor to which it is attached should be strengthened with a generous piece of plank. For securing hangers we think lag screws to be superior to bolts with nuts, where there is sufficient thickness of wood. A wooden straight-edge reaching from one bearing to another is better for leveling hangers and boxes than a twine, which will sag more or less. Some use short cylinders of iron turned to fit the box and having a central hole drilled longitudinally through them. This is an excellent plan, as the eye may sight through, or a string be passed through to determine the level.



Where holes are to be bored through the floor close to a wall, post, or other vertical obstruction, a handy tool, similar to that shown in Fig. 1, comes into play: It is easily forged and need not be finished with the elegance of contour our artist has seen fit to give it. A is one of the yokes and B the cross; they are seen united at C. The shank of one yoke has a tapering square hole to receive a bit or auger, and the other is a tapering square shank to fit the stock of the bit-brace! The device is a "universal joint" and can be readily worked at an angle of 45°. (The engraving shows an angle of 90° to exhibit its construction more perfectly).

The method of laying out belt holes through floors to avoid unsightly patches on the floors, occasioned when belt holes

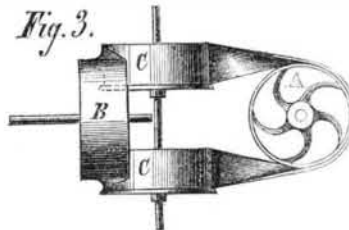


are laid out by guess, we published on page 169, Vol. XVIII, but will re-introduce it here. If a belt is to be carried from a pulley on an overhead shaft to one on any floor above, the distance from centre of lower shaft to ceiling—under side of floor—should be measured and noted; then the thickness of floor; next the distance between top of floor and centre of upper shaft. If one pulley or shaft is directly over the other, the size of pulleys and width of belt being known, you have all the data necessary, if you measure the distance of one shaft from the wall of the building, which is done by dropping a plummet from centre of shaft or diameter of pulley and measuring to the wall from that point. From these data, whether the two shafts are in the same vertical plane, whether the diameters of the pulleys are equal, and whether the belt is to be carried through one, two, three, or even four floors, or not, the intelligent mechanic can lay out a diagram that will enable him to cut his belt holes accurately. The diagram may be laid out full size on a swept floor, or on a reduced scale on a board or sheet of paper. Measures thus made can easily be transferred to the floor through which the holes are to be made.

For a "quarter twist" belt we cannot do better than re-publish a diagram (Fig. 2) produced on page 85, Vol. XVIII, with the writer's direction. Lay out on a floor with chalk line and "tram" two views of the pulley, or by scale on paper, as above.

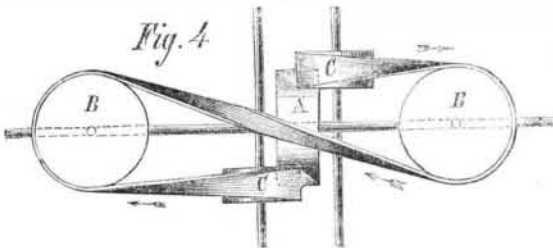
B is the belt running in the direction of the arrow on to the lower pulley, and C is the belt running in the opposite direction. Therefore, drop a plumb line representing the perpendiculars, B and C, and draw the diagonals governed by the diameters of the pulleys, marking the distances *a b* and *c d* on the floor, A. Now drop a plumb line from each side of the centre of face of upper pulley to the floor and from one point *c*, thus found, lay off the distance, *a b*, in a line parallel with the upper shaft, and from the point *a* the distance, *c d*, parallel with the lower shaft. These points are the places at which the holes should be cut.

"Quarter turned" or "corner turned" belts are run generally by the device seen in Fig. 3, which represents two shafts placed at right angles, the belt from A or B passing around two flanged pulleys, or guides, C, turning loosely on a fixed upright shaft, and sustained in position by a collar under the hub



of each. It is possible to run pulleys by this device which not only have varying diameters, but the shafts of which are on different levels, but the results are not so good, owing to unequal strain on the belt. It is better to confine this method to shafts on the same level and to pulleys of equal diameter, and the useful limit of angle of shafts is that of 45° or less. A greater, or more obtuse angle is better run by means of guides on two uprights.

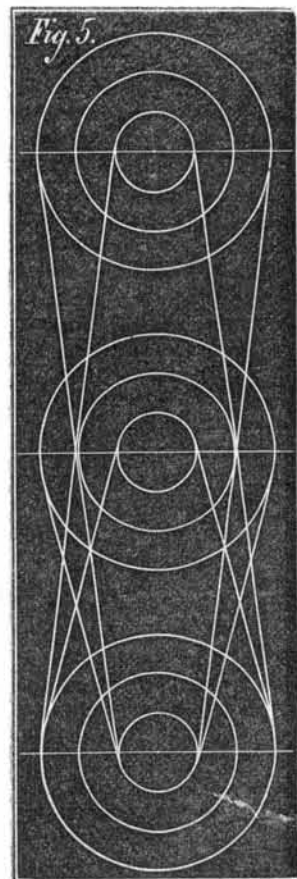
Since the preparation of these papers we have received several communications on this subject, one of which, with the illustration, Fig. 4, we introduce: The plan is to drive two



shafts, at right angles to the main, by one belt. The belt passes from the top of the pulley, A, on the main shaft, around C, to the top of B; then from the bottom of B, around C, to the bottom of A. The shafts of C may turn with the pulleys and be supported in an elegant iron frame. The belt will run either way. W. H. H. Whiting of Chicopee, Mass., is the inventor.

• Another writes that the variations of cone pulleys are not correct, the belt being the tightest on the fast speed, whereas it should be the reverse. The diagram, Fig. 5, will show the reason why and suggest its own remedy. It is only necessary with a pair of dividers to measure from the centres of the pulleys shown by the horizontal lines to the points of contact of the belt, on either pulley, at either distance between shafts. Our correspondent and our intelligent readers generally will readily understand the case from an examination of the diagram.

Pulleys may be balanced by swinging them on arbors between lathe centres and noting their positions as their gravity determines it. On the top side drill and tap two holes, in which seat machine screws with flat heads the shanks projecting through from the face or outer side. Then by securing pieces of iron as weights to this point until the pulley is balanced the amount necessary to balance the pulley is found. This amount of lead is then melted and cast in a mold formed by clay. The screws serve to hold the lead in place. Modifications of this plan will suggest themselves to the mechanic.



If set screws are preferred to keys in securing pulleys, it is best to make them of cast steel, with hollow points, the ends beveled to an edge surrounding the hole, and tempered to a dark straw. When set up, these screws cut circular indentations on the shaft and exert an enormous force of resistance. Belts should be run with grain side to the pulley, it being found that they will drive 34 per cent more than with flesh side to the pulley. Pulleys covered with leather, iron pulleys polished, and mahogany pulleys polished, rank for working value as 36, 24, and 25 per cent, respectively, wood and iron uncovered being almost identical.