Internal Combustion Engines.

At a recent meeting of the Engineers' Club of Philadelphia, Mr. Paul A. N. Winand presented some figures as to the cost of power in using internal combustion engines.

"The attendance in gas and oil engines is probably not more than in the engine part of the steam engine, and in the newer styles of gas engines, working without slide valve, the amount of lubrication is also about the same, and in a comparison between the two classes of engines, these items can be omitted.

"Considering the question of cost of power in a general way, that is, independent of any combination with other apparatus, gas and similar engines are often cheaper to run than steam. Illuminating gas costs generally from $1.00 to $1.50 a thousand. As shown in the Society of Arts trials, a gas engine of about ten horse power can be run with 22·6 cubic feet of gas per brake horse power. Better results than this have been obtained, but at this figure the cost is 2·2 to 3·3 cents per horse power. This is about equal to 13 to 19 pounds of coal at $3.50 a ton. Nevertheless, it is mostly cheaper than steam for powers up to fifteen horse power, especially when the plant is run spasmodically. When a gas engine is used to make incandescent electric light, 22 cubic feet of gas will be used for about nine 16 candle power lamps, or 140 candles. The same amount of gas burned as such would give only about 90 candles. The number of lamp hours per year will decide as to whether it is cheaper to burn gas directly or not.

"In actual work a gas or oil engine keeps more nearly to its original economy than a steam engine, because a steam engine will run with valves and pistons in bad order, while a gas engine refuses to go if the supply of gas is not about properly adjusted.

"In an official statistical inquiry as to the economy of power, made by the authorities of Birmingham, the fuel consumed was much higher than might be expected from published results of tests, on non-condensing engines being not below 9·6 pounds, with an average of eleven pounds of coal per horse power hour.

"Oil or gasoline can be used with about the same efficiency as gas. One gallon of oil is about equivalent to 180 cubic feet of illuminating gas, and, accordingly, it takes about one-eighth of a gallon per horse power hour. This, at 5 to 10 cents a gallon, is equivalent to 7½ to 3½ pounds of coal at $3.50 per ton.

"With natural gas 15 cents per thousand, one horse power costs about one-fourth of a cent, as it takes only about 16 cubic feet per horse power hour, and it would take three to four times as much gas firing under a boiler for the same power. Using the coal in a producer to make gas and then using it in the gas engine for power is one way of running a gas engine plant. The efficiency of a gas apparatus is from 70 to 80 per cent. With such an apparatus, a consumption of 0·935 pound of coal has been attained in France, and even 0·883 recently per horse power hour in England."

Mr. Strong—One of the most interesting papers I have read on the subject of the cost of power was by Sir William Thomson, in 1881. In this paper the sources of power were divided into four, which were wind power, falling water, tidal energy, and coal. The first two of these are due directly to the sun's heat, and, what might at first appear strange, the first of these has had more to do with the comfort and progress of this world than any other power, and it is probable that the time will come again when wind power, in connection with some such apparatus as the storage battery, will again do the work of the world.

Tidal energy and water power he regarded as insignificant. The burning of coal he also considered as one of the sources of power which was derived from the sun's energy.

Prof. Elihu Thomson read a paper in Boston recently, and said that the hope of the electrical engineer was in the steam engine, or that the mechanical engineer would produce cheaper power than by the steam or gas engine.

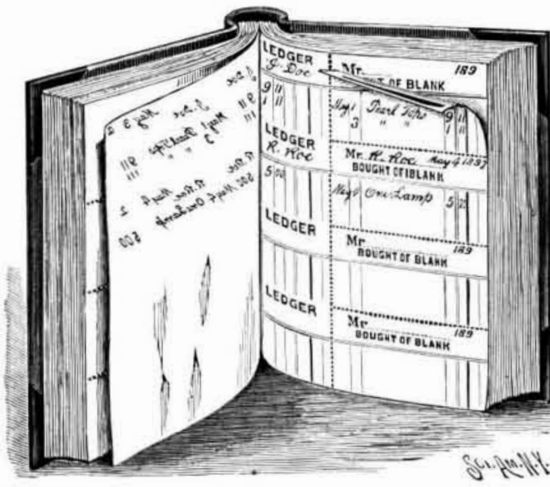
Clark says that it is possible to use 40 per cent of the energy in the coal through the gas engine, while the best steam engine only uses 13 to 14 per cent.

The difficulty in the way of introducing producer plants and gas engines is the first cost and the difficulty of starting the engines, but this latter difficulty will probably be soon overcome, and the gas engine will then supersede the steam engine in many cases. We have been engaged in designing an engine which is to make a horse power on 13 pounds of water, and in the boiler we expect to carry 180 pounds pressure, allowing the gas to escape at 250°, and evaporating 12 pounds of water to a pound of coal.

NITROUS acid as a disinfectant had been proposed some years ago because of its peculiar property of being an oxidizing as well as a reducing agent. H. Borntrager employs the following combination containing 20 per cent sodium nitrite: One part sodium nitrite and one part gypsum are melted together; after cooling the mass is powdered and preserved in well-stoppered receptacles. Two parts sodium bisulphate and one part gypsum are also melted together and, after cooling, powdered. Both powders are now mixed and preserved in dry and tightly-stoppered containers. If this powder be thrown into water or substances to be disinfected, a uniform evolution of nitrous acid takes place, which rapidly destroys foul odors.—*Pharm. Centralhalle.*

A COMBINATION ACCOUNT AND BILLING BOOK.

A book which combines within itself three books, such as used in mercantile business, is shown in the accompanying illustration, and has been patented by Mr. James E. Depue, of Oakland, Cal. The combination embraces a general ledger, a sales book or personal ledger, and a billing book, and is designed to lessen



DEPUE'S LEDGER, SALES AND BILLING BOOK.

the labor of the book-keeper, and facilitate the keeping and rendering of accurate accounts, while doing away with a multiplicity of books. The book contains two classes of leaves bound together, main or entry leaves and intervening transfer or copying leaves, whereby a press copy may be taken of the writing on the main leaves. Each of the latter has its inner end portion ruled to form a column of ledger spaces, the front portion of the sheet having, opposite each ledger space, a space corresponding to the leaves in a sales book or a billhead book, ruled to enter the usual items of account, dates, charges, etc., each of these spaces also bearing a special number printed in copying ink. This outer portion of each main leaf is designed to be detached when desired, for presentation as a bill or memorandum, and this portion of the sheet is therefore separated from the ledger spaces by a vertical row of perforations, to facilitate its ready removal, a press copy of the account being previously taken on the copy or transfer leaf. The latter, remaining bound up in the same book as the main sheets, shows the general ledger account from the inner portions of the main sheet, and the personal ledger or itemized accounts from the outer portions, and may also be detached for presentation to customers if required, a bill being thus ready to detach and present to a customer at any time.

A DESK INK BOTTLE.

An ink bottle particularly adapted for use on school or other desks is shown in the accompanying illustration. It is provided with a simple, convenient, and

HALL'S INK BOTTLE.

reliable attachment, affording means for the secure connection of the filled bottle with an aperture in the desk, the orifice in the bottle being flush with the upper surface of the desk top and the body of the bottle being hung in the desk. The aperture in the desk is made of a size suitable to receive a cylindrical thimble with a radial flange, which, when seated on the desk top, retains the thimble in place. The neck of the bottle has an exterior thread loosely fitting a thread within the thimble, so that the parts are readily secured together in place as shown. The neck of the bottle is designed to be closed by a cork, and a laterally swinging cover, as shown, may be used if desired.

This improvement has been patented in the United States and Great Britain by Mr. William F. Hall, Box 247, Rapid City, South Dakota.

How Society is Indebted to Invention.

In the "Relation of Invention to the Conditions of Life," in the *Cosmopolitan Magazine*, Mr. G. H. Knight says:

With each step in industrial progress not only is the greater the number who can be warmed, fed, and clothed and the better are their life conditions, but in default of such progress a vast majority would not have lived at all. It is to industry guided by scientific methods, and to science that concerns itself with practical applications of its discoveries, that we are indebted for such magical arts as that which makes light itself depict for posterity the very features and expressions of the life it once illumined; for the kindred art whereby scenes in the most remote regions are made to pass in realistic panorama before the pleasantly cheated vision; for the instrument which, having analyzed the sunbeam and revealed the chemical constituents of distant constellations, becomes, in the hands of the metallurgist, the means of determining the precise instant at which to arrest the process of "conversion" in the Bessemer steel manufacture. It is to invention that society is indebted not alone for the refinements, but for every necessary of modern life; for food, clothing, and shelter; for the arts of spoken, written, and printed speech; for the means of flashing the very voice to a listener in a distant city, or catching the fugitive, tremulous tones and storing them for the delectation of generations yet unborn; for music, poetry, and the plastic arts; for locomotion by land, by sea, and even through the circumambient air; for the gift of soothing with healing wings the bed of anguish; for the ability from this tiny speck of earthly life to sound the abysses of time, thought, and space.

Wormy Tobacco.

In answer to a communication of Mr. E. L. Moore, of Glidden, Texas, relating to insects damaging stored tobacco, Prof. C. V. Riley says:

The question relates to the so-called cigarette or tobacco beetle (*Lasioderma serricorne*). This is a cosmopolitan insect, which feeds, all over the world, on a number of stored food products, and which, curiously enough, seems to have a preference for pungent stuffs, such as pepper, tobacco, etc. It has even been recorded as feeding upon Persian insect powder, probably, however, after this useful insecticide has lost some of its power through partial exposure to the air. In this country it has done considerable damage in tobacco factories, particularly from Baltimore southward. The female beetle lays her eggs in exposed tobacco, and from these there are hatched small white larvæ, which feed extensively for some weeks, afterward transforming to pupæ and issuing again as perfect beetles in from two to five months after the eggs were laid. Every precaution should be taken in factories to leave as little exposed tobacco about as possible, particularly at night, as the insects fly by preference at this time and lay their eggs. The factory windows should not be left open, and persons engaged in rolling cigarettes and cigars should cover their tobacco at night, while all waste tobacco should be swept up carefully and placed in some closed receptacle. Where a lot of tobacco has once become infested, the only remedy consists in steaming it thoroughly. The application of any of the insecticide substances cannot be recommended, as their use would injure the tobacco and might prove dangerous to those who subsequently used it.

Smoke Turned into Money.

In his inaugural address to the North-East Coast Institution of Engineers and Shipbuilders the other day, Mr. Wigham Richardson referred to the chemical treatment of smoke. He said: "We know how the heated nitrogen and the carbon oxides, which used to be belched forth from the blast furnaces, are now used to raise steam in the boilers which supply the blowing engines; but Mr. Ludwig Mond, of the firm of Brunner, Mond & Co.—the same who has introduced the Solway process for making soda, and in so doing has hit many of our friends so hard—has, as I understand, gone much further. He burns his coals with artificial draught, and, conveying the gases into a chamber, he washes them with water spray, which causes every particle of soot or smoke to be deposited, and at the same time condenses and recovers the ammonia (a product of nitrogen and hydrogen), as well as the sulphurous fumes. I trust that I have not misunderstood Mr. Mond's figures; but I gather that to get an equal efficiency of steam-raising power he has to burn 125 tons of coal in place of 100 tons, and for every 125 tons of coal burned he recovers four tons of sulphate of ammonia. The fuel, if cheap (say $1.25 a ton), will cost $155, and the sulphate of ammonia at $60 a ton is worth $240. If results such as these can be attained the doom of smoke is sealed."

A Sixty Thousand Volt Transformer.

Before a recent meeting of the Old Students' Association of the City and Guilds of London Institute, Messrs. H. B. and W. F. Bourne showed some remarkable experiments with a 60,000 volt (4 horse power) transformer. The transformer used was one having a ratio of 800 to 1, the insulation consisting of paper and oil. By the aid of this transformer Messrs. Bourne were enabled to show that many substances which are usually regarded as excellent insulators afford facilities to the passage of the current. For instance, a discharge was shown across the surface of a sheet of ebonite many times longer than the sparking distance in air. Slate, too, was shown to be a partial conductor, two slate pencils acting perfectly as the carbons of an arc lamp. A block of salt about the size of a brick, when slightly damped, allowed the current to pass freely through it and play over its surface in a brilliant yellow flame.

The experiment shown by Mr. Tesla, since repeated by Messrs. Siemens, of a sheet of glass interposed between two flat terminals was also exhibited. A blazing network of threads of fire darted over the surface, a small hole being finally pierced, the edges of the perforation being melted and the hole filled with liquid glass, through which the current found its way. In the case of a specimen of good rubber-covered cable with bare copper wire wound over a small portion and acting as a concentric cable, the dielectric when subjected to 20,000 volts soon heated, owing not to conduction but to absorption currents, and soon broke down and caught fire, the rubber being quite softened by the heat in 15 minutes. Messrs. Bourne had a good deal to say about oil insulation, and it has been found that the heating due to absorption currents is very much less in liquids than in solids. There seemed to be very little to choose between different kinds of oil, those having a high specific inductive capacity apparently heating the most.

An interesting experiment with two different oils was shown. Colored castor oil was poured into a glass beaker and a layer of paraffine oil floated above it. Flat ended electrodes were connected to the transformer, and the surface of the castor oil was seen to rise or swell in the center. It was suggested that this was due to the tendency for the capacity of the system to increase, the specific inductive capacity of castor oil being greater than that of mineral oil. It was found that the sparking distance in oil was greatly diminished by the presence of dust or other impurities.

Transformation of a Cable Road.

Building cable railways in cities and then replacing them with the more efficient electric system is a costly experiment, as the following from the St. Louis *Globe-Democrat* will show:

In about thirty days the curtain will go down upon the last act of that magnificent but costly experiment which was formerly known as the St. Louis Cable and Western Railway. For three weeks workmen have been busy tearing down and removing the great wheels and cable machinery which have stood in the old power house at Channing and Franklin Avenues since 1888. It will take a month to complete the work. When it is done the last vestige of the equipment of the old road will have disappeared, except a few cars in the car house beyond Vandeventer Avenue. It will be remembered only as a victim of the relentless progress of electricity, which has driven it out and replaced it.

The road was not only the first one in the city to be operated by one of the new methods, but it was, in some respects, unique. This was particularly true of the iron conduit through which the cable ran. At the time when it was laid, cast iron was worth about three times as much as its present price. The projectors of the road believed that they could find a cheaper material. They therefore conceived the novel idea of using wrought iron. In carrying it out, rails were melted and forged into the shape of the yokes, joined sections of which formed the conduit. The plan proved expensive in the end. Over 3,000,000 pounds of iron went into the conduits and tracks. It cost somewhere in the neighborhood of $150,000. The other day it was sold by weight to Col. Hirsch for about $30,000. It was fit for nothing but to be shipped away, melted up, cast into pigs and billets, and sold again as raw material. But the road had, for the time, the distinction of being the only one in the world with a wrought iron conduit.

While it was run on the cable system the road used more cables than any system of equal length in existence. This proved another very costly feature. The life of a cable on most roads averages about nine months. The Cable & Western Company found it necessary to put a new one down every five months. Each cable weighed from thirty to forty tons. The average price was 12 cents a pound. Thus, the cost of cables alone reached about $20,000 a year, to say nothing of the cost of transporting and laying them. The number of very sharp curves in the line served to wear out the cables with distressing rapidity. Each cable is composed of a number of interwoven strands of fine wires not more than a sixteenth of an inch in diameter. The strain on the curves was too much for these. When the cables wore out, they, too, were useless, except as old steel. They were sold to the iron dealers for 3 cents or 4 cents a pound.

When electricity proved successful as a motive power and proved so much cheaper as a means of operating, it became evident that the only method of successfully running the road would be by discarding the cable system and adopting the electric. In this respect the road is also unique. It is the only one in the world which has been completely torn up from end to end and replaced with an entirely new equipment. At the present time the only things used on the road that were used under the cable system are the two engines which ran the cables and now run the dynamos, with the help of two new ones. For some time after the transformation of the road the immense drum wheels, fly wheels, and other machinery lay idle in the Channing Avenue power house. Under the new system it was useless. Finally it was sold to the original builder, the Walker Manufacturing Company, of Cleveland, O. Under its direction the work of removing it is going on. The great weight of the pieces necessarily renders it very slow. The great fifty-ton fly wheel has to be handled with the utmost care, notwithstanding the fact that it is cast in four pieces. The immense drum wheels have been partially moved with a derrick and pulleys. The outer rims, in which the cables formerly turned, have been carefully removed. The framework, upon which the machinery rests, contains hundreds of tons of iron, which will be packed upon cars and shipped to Cleveland.

Although the machinery was sold at a figure far below its cost price, it is still in remarkably good condition, and will probably be utilized elsewhere for the purpose for which it was originally designed. The thirty-nine old cars of the cable company, stored in the Vandeventer Avenue car house, will probably get into active use during the coming summer. The officials of the road state that they expect a 50 per cent increase in their business during the heated months, and they expect to be obliged to put on at least a part of the cable cars. Such as are not used will be sold, and then there will be nothing upon the streets to remind St. Louis people that the pioneer cable road of the city ever existed.

Experiments with Celluloid.

A correspondent recently forwarded us three varieties of articles made from the material known as celluloid, viz., an imitation ivory dice box, an imitation tortoise shell hairpin, and a variegated pattern of a toy bouncing ball. In view of the possible dangers arising from the use of buttons, hairpins, etc., made of this material, we have submitted the above to experiment, and the results are perhaps of sufficient interest to justify record. The articles were, without exception, highly inflammable. On applying a light they burst instantly into a brilliant smoky flame like that produced when camphor is ignited. It was not difficult to blow the flame out, but dense fumes continued to be given off which were quite as inflammable as coal gas, and, on placing a light in the stream of smoke at a distance of six inches above the material, a bright flame instantly ran down and reignited the article.

Portions of the three articles were next placed on paper at a distance of eighteen inches, in front of a red-hot fire, where the temperature was ascertained to be 100° C. (212° F.) Beyond the softening of all the pieces, and a slight swelling of the tortoise shell and toy ball sections, no signs of ignition could be observed. The paper on which the articles were resting was then placed about twelve inches from the fire, where the thermometer showed a constant temperature of 110° C. (230° F.), *i. e.*, ten degrees above boiling point. In ten minutes the pieces of thin celluloid, of which the ball was composed, swelled out, emitted dense fumes of camphor, and charred, without, however, showing any sign of flame, while the paper was only blackened and scorched. In fifteen minutes precisely a similar occurrence happened to the hairpin, the imitation ivory being as yet unchanged. Another hairpin and a fresh piece of the toy ball were then placed along with the yet unfired ivory specimen within six inches of the fire. The piece of toy consumed rapidly away in little over a minute, apparently without flame, and the hairpin followed suit in about three minutes. The paper upon which they lay was charred only, not actually ignited. The imitation ivory showed slight swelling under these conditions, but not until the temperature was raised to 145° C. did it puff up and give off abundant smoky fumes of camphor, as in the previous experiments. In no case could it be said that the combustion was accompanied by flame, nor was the paper upon which the articles were resting actually ignited; it was only scorched and charred.

The difference exhibited by the ivory specimen in susceptibility to the influence of heat may possibly be accounted for by the fact that, first, it is more dense, and, secondly, it contains a fair amount of zinc salt. On ignition the ash was found to consist almost entirely of zinc oxide.

The addition of this metallic salt serves probably to make transparent celluloid opaque and to give it the appearance of ivory. The tortoise shell pins contained no zinc, and yielded very little ash at all; and while in the toy ball, which was of variegated pattern, the white opaque spots contained the metal, none was found in the clear portion of the material. All the specimens emitted a strong odor of camphor on rubbing, and more especially the tortoise shell and transparent variety. Ether also dissolved out camphor from each of the specimens.

It would appear from these experiments that celluloid is, generally speaking, not so dangerous as might be supposed, although, in view of the testimony recently furnished by Professor Boys, F.R.S., of the inflammability of buttons made of this material, there are exceptions; but probably these exceptions depend upon a variation in the composition of the celluloid, some preparations, perhaps, containing more pyroxylin, and accordingly less camphor, than others. The manufacturers of celluloid would in any case do well to give their attention to this matter, and by adopting a process which will secure greater certainty in the composition and character of this beautiful material, or by incorporating with it some substance which will render it practically non-inflammable, rid it of the one quality which at present would seem to render its general use not quite safe.—*Lancet.*

World's Fair Progress.

The number of men at work on the grounds and buildings at Chicago is now 5,000.

Mrs. Potter Palmer, President of the Board of Lady Managers, has undertaken to erect, equip, and maintain a building 90 × 150 feet, wherein babies and younger children can be left when their mothers are viewing the sights of the fair. Nurses, attendants, games, etc., are to be provided.

It is proposed to run from New York to Chicago, at the time of the dedication of the exposition buildings, ten special trains, ten minutes apart, each train to have elaborate decorations and music. It is believed that fully 5,000 people will want to make the trip.

Workmen have begun raising trusses to support the roof of the Manufactures Building. These trusses will be the largest in the world. There will be 22; each will cover a span of 688 feet. Over the center of the roof, inside, to the ground floor, will be a distance of 206 feet. Each truss weighs 200 tons. A total of 6,000 tons of steel will be used in the roof of the building.

The Reichstag has passed to a second reading a bill granting a supplementary credit of $500,000 for the German exhibit at the World's Fair.

The fountain which is to stand at the foot of the main basin in Jackson Park is projected to be the largest in the world. It was designed in Paris by Sculptor McMonnies, of New York. A force of modelers and blacksmiths are working on it night and day. The idea is an apotheosis of modern liberty, Columbia assuming the shape of a triumphal barge guided by Time and heralded by Fame. There will be eight standing figures, representing the arts, science, industry, agriculture, and commerce. Eight mammoth sea horses will form a circle directly in front of the fountain, and their nostrils will spurt great streams of water. They will be mounted by stalwart young men as outriders, to represent commerce. The design of the basin is circular, 150 feet in diameter and flanked on each side by columns 50 feet high, surmounted by eagles.

Many States are preparing to appropriate more money than they at first intended. The aggregate is now $3,180,000. Maryland and New York have voted respectively $60,000 and $300,000; New Jersey has added $50,000 to its appropriation of $20,000; Iowa has added $125,000 to the $50,000 already granted; and Massachusetts has doubled the $75,000 previously appropriated. Minnesota will supplement its $50,000 by $100,000 raised by subscription, nearly three-fourths of which has already been raised. Minnesota will spend $25,000 on a State building.

Creosote in Tuberculosis.

After nine years of experience with small doses of creosote (half a grain daily), Dr. Julius Sommerbrodt, in 1887, expressed himself as inclined to the belief that in the first stages of tuberculosis of the lung creosote can cure. After using larger doses (1 to 2 grains daily) lasting cures were recorded in long-continued and severe cases, and after continuing his observations he reports (*Berl. klin. Wochenschr.*, October 19, 1891) that creosote, in large doses (1 to 4 grains per day), is, for countless cases, unsurpassed as a curative agent in tuberculosis of the lung. For a patient over 10 years his minimal dose is 1 grain daily and his maximum dose 4 grains daily. He has never found bad results from his largest doses. The excipient is of importance. He prefers to give it with cod liver oil in gelatine capsules, containing one grain of creosote. It keeps best and is best absorbed and best taken in this form. His patients have no other medicine. It usually takes two or three months before its influence is very noticeable. Great numbers of his patients have taken five, ten, twenty thousand capsules *continuously* without a bad symptom, and with excellent appetites, and this in itself is an answer to the objection that it injures the stomach.