SCIENTIFIC AMERICAN

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RELIANCE RUNNING "WING AND WING" FOR THE FINISH.

Tip of main boom to tip of spinnaker boom, 201 feet. From water to highest point of sail, 190 feet. Total area of sail, 16,169 square feet.—[See page 152.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, AUGUST 29, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

COLOMBIA AND THE PANAMA CANAL.

Not a little anxiety has arisen among the advocates of the Panama Canal because of the disposition of Colombia to make trouble over the canal treaty which has been submitted for her consideration. After the treaty had been subjected for many months to the devious ways of South American diplomacy, the announcement was cabled that it had been rejected by the Colombian Senate. Later advices, however, are to the effect that another proposition is under consideration, and that the President of Colombia will be authorized to negotiate a treaty with this country along certain lines which will be agreeable to the interests, fancied or real, of the South American republic.

As far as they are intelligible to the average citizen of this country, the objections of Colombia are due, first, to its reluctance to give up its absolute sovereignty over the strip of land through which the canal runs, and, secondly, to the conviction that in letting this land go for ten million dollars it is not making the most of the occasion; in other words, that it is selling too cheaply to a country whose treasury is overflowing with abundance. The first objection is invalid, for the reason that the treaty was framed so as to safeguard the interests, or rather the sensibilities, of the South American republic on the question of sovereignty, the transfer being in the nature of a lease and not of an out-and-out sale. With regard to the second difficulty, it is hard to see that ten million dollars is, under the circumstances, anything but a fair rental; and in view of the fact that the construction of the canal will be of untold advantage to the republic in the introduction of capital and the promotion of commerce, the terms are decidedly liberal.

The greatest danger in connection with the present hitch in the negotiations is that political capital may be made out of it in our legislature, and that the Colombian Senate may thereby be encouraged to prolong its opposition. It is sincerely to be hoped, however, that the opponents of the Panama Canal will be prepared to take a broad and patriotic view of the whole question, remembering that the choice of routes was decided upon by an overwhelming majority, and that was made after a more thorough and searching investigation of the problem than was probably ever before given to a great engineering scheme of the kind. As to the suggestion which was recently made in the daily press that we still have Nicaragua to fall back upon, it may be dismissed with the statement that since the Panama route was chosen, there has been a growing conviction that the Nicaragua route was not merely the more difficult of the two to construct, but that there were certain physical features inseparable from it, which rendered the construction of a safe and durable canal impossible.

A PROBLEM FOR THE AIR-SHIP BUILDER.

The information which is attainable regarding the dirigible balloons which are to compete at the coming St. Louis World's Fair, makes it evident that there will be a great increase of power over any machines that have previously been tested.

This increase will introduce some problems of strength and resistance which the builders are liable to overlook. So long as motors ranged from 6 or 8 to 20 horse power, the speed of the balloon was necessarily so low that the question of head resistance did not enter seriously into the problem; but with the introduction of more powerful engines and higher speeds, builders will do well to make provision against distortion of the front end of the cigar-shaped balloon, either by transverse buckling, or by the whole head being forced back and flattened upon the balloon itself. Moreover, should the cigar-shaped structure be suddenly deflected from its course when at high speed, the transverse strains would be so serious as to require especial provision of longitudinal strength in the body of the balloon. Just how to provide this strength in the silk and net-covered envelope is a question which is certain to occupy the attention of aeronauts very closely in the immediate future. We are aware that at present dependence is placed upon the longitudinal stiffness of the car or operating platform, which is usually built of a triangular cross-section, with a view to its affording, through the supporting stays and guy ropes, the necessary stiffness. Count von Zeppelin was working along the proper lines when he constructed his balloon entirely of metal, but like Brunel with the "Great Eastern" he was many years ahead of the art. His machine was altogether too large for the limited power that it carried. Nevertheless the indications are that if the dirigible balloon is to be the type of airship of the future, some form of light but strong metal shell, provided with internal trussing, will have to be adopted in place of the present silk fabric. Such a balloon, built of the proper form and strength, in conjunction with a motor that weighed not over a pound to the horse power, would go far to make the dirigible balloon a practical and useful invention. But even when that time is reached, if it ever is, the perfected balloon will not be comparable in its speed or efficiency to a perfected airship of the aeroplane type, for the latter is Nature's own method of flight, and it has every scientific consideration to speak in its favor.

DIRECT CURRENT VS. INDUCTION MOTOR FOR ELECTRIC TRACTION.

Alternators that supply energy to transformers and rotary converters located in substations make it practicable to operate direct-current motors at any distance from a generating plant that can be economically covered by transmission at high voltage. In many cases electric cars with such motors are operated at 30 to 50 miles, and in a few instances at nearly 100 miles from the stations where the power is generated.

The amount of power that may be delivered as direct current at 500 volts through a single trolley contact, when the current comes from a substation, is limited by the ampere capacity of the contact, just as when the current passes directly from generators to car motors. Cars operated by a substation at 500 volts are under similar limitations as to distance from that substation to those which would apply with a generating station at equal voltage. As long as the continuous-current car motors are supplied by a station where the voltage is held substantially constant, the torque of these motors is obviously independent of the fact that the station voltage is maintained by dynamos or by rotary converters. A substation with transformers and converters is frequently designed for the operation of a much smaller number of cars than a generating station would be. From this it follows that a bunch of heavily loaded cars at some point on a line is much more apt to cause a drop of voltage at a converter station than at a generating station. When the station voltage goes down under an overload, the possible current in car motors, and consequently their torque and power of acceleration, is rapidly reduced. High-voltage lines with alternating current may deliver their energy directly to each car or train instead of to substations, and this energy may be changed to continuous current by a transformer and motor generator or converter on the car. This plan raises at once the limit to the power that may be delivered through a single trolley contact to a point above present requirements. Thus if continuous current motors working at 2,000 horse power are supplied with energy through transformers and rotary converters on their car or train, the efficiency of the combination being 80 per cent, then the trolley contact will carry only 125 amperes if the line voltage is 15,000. There is little doubt that current at 15,000 to 20,000 volts can be collected from an overhead trolley wire over a private right of way. If two trolley wires are used, as is necessary with three-phase currents, the best plan is to mount one trolley wire on each side of the track, so that an arc between them will not be possible. With these voltages at the trolley wire cars may be operated more than 50 miles from the generating plant without an excessive loss in or weight of conductors. Continuous-current motors operated by a motor generator or rotary converter on the same car or train have all the capacity for torque that they would have if operated directly by continuous-current generators. As each car or train thus carries its own substation, the motor torque will not be cut down by an overload of cars on one section of a track.

The continuous-current, series motor, constructed with a laminated magnet frame, operates with its usual torque and other properties when supplied with single-phase alternating current, except that there is excessive sparking at the brushes. A prominent manufacturer claims to have overcome this sparking, and if this claim proves to be correct, the continuous-current motor may be operated with alternating current of single phase either direct from generators, from transformers at substations or from transformers on the car driven by the motor. Such a motor evidently does away with the necessity for either motor generators or rotary converters.

Induction motors operating with alternating current of two or three phase, when supplied from transformer stations at about 500 volts, are subject to similar limitations as to the power that may be delivered through a single trolley contact, and the radius of transmission, with continuous-current motors under like circumstances. If transformers are carried on the car with induction motors, the limits as to the length of transmission and power delivered through a trolley contact again correspond to those for continuous-current motors, but the motor generators or rotary converters are dispensed with. As induction motors have no commutator, and their windings, which are in electrical connection with the line, may be stationary as to a driven car, it is practicable to distribute alternating current from generating stations or substations directly to the car motors at voltages much above those that can be safely applied to continuous-current motors. This application of comparatively high voltages to induction motors gives their cars a longer radius of operation from substations or from generating stations where no substations intervene than can be had for cars driven by continuous-current motors. If rotary converters and motor generators are omitted from substations or cars and induction motors used instead of continuous-current motors, the capacity of transformers must be materially increased beyond what it would be with the continuous-current motors. This increase is necessary because for a given increase of torque a much larger current is required by an induction than by a continuous-current motor. The saving as to converters or motor generators must be invested in part at least for transformers. Where induction motors are used for traction, a limit must be applied to line losses that is not present with continuous-current motors. As the torque of continuous-current motors depends simply on the amperes in their windings, the line losses in traction systems that employ such motors are designed to give good average economy, while the maximum loss of pressure in these lines at times when cars are started with heavy loads may be very large. The lower voltage thus available at continuous-current motors when starting simply cuts down the car speed for the moment. On the other hand, the torque of an induction motor varies with the square of the voltage at its terminals, so that a moderate increase in the loss of pressure on the line results in a great reduction of motor torque. The maximum loss that can be permitted on lines supplying induction motors for traction purposes is thus very limited. The most serious limit encountered with induction motors in traction work is that of torque and power of acceleration. At most the three-phase motors in traction work are able to give a torque two or three times that at rated load and speed. Continuous-current motors are usually designed to operate at full rated capacity when driving a car with average load and maximum speed on a level. When a car is required to start with a heavy load, the inherent capacity of the continuous-current motor gives a torque of five, ten, or more times the normal as may be required. On electric lines, where cars make a large number of stops and yet maintain a fair average rate of speed, the acceleration of cars at starting is often at the rate of three to four miles per hour per second with continuous-current motors, and can readily be made still higher if desired. With induction motors designed for average car loads the highest rate of acceleration that can be got when starting under load is about 1.5 miles per hour per second. This limit on the torque and accelerating power of induction motors unfits them for the great bulk of present work in electric traction. It may of course be suggested that the motor capacity on each car be so increased that the necessary starting torque can be obtained. One objection to this plan is the fact that under it the induction motors would be working on partial loads and at poor efficiency most of the time. Another objection is the increased cost of two or three times the present motor capacities on electric cars. Induction motors with their narrow torque limits thus lack one of the strongest elements in the present success of electric traction. A. D. A.

On July 24 the last chain connecting the Dayton & Western Traction Company with the Richmond Street and Interurban Railway was laid, thereby completing one of the longest traction lines in the world. The line extends from Indianapolis, Ind., to Dayton, Ohio, a distace of 150 miles. In a short time the service will be extended to Columbus, Ohio. A through service from Indianapolis and Dayton will be established as soon as possible with the largest make of interurban cars. As the line runs parallel to the Pennsylvania Railroad all the way it is expected that company will be given stiff competition.

THE TRAP-LANTERN AS AN INSECT EXTERMINATOR.

BY HAROLD BOLCE.

To determine whether the beneficial insects captured in trap-lanterns outnumber the noxious species destroyed by these lures, entomologists throughout the United States are conducting interesting experiments.

At one station classification of the insects caught in a lantern, run every night for five months, disclosed that to a great extent it was the beneficial insects that had been captured. Species like lace-wings (Chrysopa), ground beetles, lady-bug beetles, fireflies, and ichneumon flies were decoyed in vast numbers, while many pests rampant in the orchard where the tests were made avoided the flame.

One orchard in eastern New York in which scientists conducted trap-lantern work was overrun with the plum curculio, yet during five months only three specimens of this pest were trapped, and that capture broke the curculio record among scientific experimenters with trap-lanterns.

The bee moth was a pest in the neighborhood, but only two were lured to destruction. A single chinch bug was caught and only twenty-three buffalo tree-hoppers (*Ceresa bubalus*, Fab.), an insect famed because of its resemblance in shape to the American bison. The buffalo tree-hopper is frequently no less destructive both to fruit and shade trees than the periodical cicada, and as it is an exceedingly quick and active flyer, it is a matter of surprise that the lanterns secured so few victims of the species. Even greater wariness was displayed by that persistent enemy of husbandry, the common squash bug (*Anasa tristis*, DeG.), not a single individual having been caught. In contrast to the seeming instinct of cunning which prompted these injurious insects to shun the light, the destruction at this station of ichneumon flies and other hymenopterous species devoted to the interests of the farmer constituted a large per cent of the entire capture. It is a matter of interest, too, that twenty-five per cent of the insects destroyed were the aquatic species known as caddice flies, which are not of economic value to agriculture, being neither beneficial nor injurious.

Another strange fact revealed by the tests was that, of the harmful insects that were destroyed, the great majority were males. In warfare upon adult insects, it is always the hope of entomologists to destroy the egg-layers and thereby secure immunity from multiplying generations to come. But in one of these experiments, 1,101 *noctuid* moths were captured, 968 of which were males. Of the crambid moths seventy-nine per cent were males, while the males of the May-beetles in the same series of tests constituted ninety-three per cent of the trap-lantern mortality of that species for that season.

Moreover, the entomologists made the discovery that, of the few female insects caught, the majority were individuals that had accomplished their destructive work for the season in nurturing a pestilent brood, and who in the ordinary process of nature would soon have come to the end of their career.

Experimenters have been much impressed with the surprising variety of trap-lantern mortality among insects. The tests have not been conducted exclusively by entomologists. Lights gleaming at night in orchards in America indicate that many fruit-growers have installed trap-lanterns for the slaughter of pests. While the results as to the kind of species caught have been a constant source of surprise, there is no question that the possible insect mortality by this method is very great. In a cotton field in Texas, three trap-lanterns in a single night destroyed 24,490 insects, representing nearly 400 species. In this big capture the injurious kind outnumbered slightly the beneficial.

The wide variety of results, so far as numbers are concerned, will be readily seen when it is stated that in a trap-lantern run steadily every night in New York state for nearly half a year, only one and one-half times as many insects were captured as were taken in one of these lanterns operated for a single night in Texas. In many orchards, trap-lanterns set a few rods apart attracted altogether different sets of species.

The student of entomology who wishes to secure without delay a large collection of insects can achieve that end by establishing a trap-lantern. In many of the scientific experiments an ordinary lantern was fastened to a brick set in a common milk pan. This was nearly filled with water, over which was poured a little kerosene. The whole contrivance was set on the top of a post about four feet high. In this oily moat around the brick pedestal of the lantern the insects met their death in vast numbers.

During the past several years enough information has been definitely obtained to guide investigators as to the best time for catching various species. Many insects a-wing throughout a season will for months resist the enticements of the flame only to rush at another period to destruction. For example, the apple tent-caterpillar moth (*Clisiocampa americana*) was lured only from June 15 to July 15. At all other periods the lantern burned for this pest in vain. It was only in August that the garden web-worm (*Loxostege sticticalis*) was found to be susceptible to the allurement. The garden crambus (*Crambus hortuellus*) was enticed only in July, while the vagabond crambus (*Crambus vulgivagellus*) was tempted only from August 15 to September 15. Two of the cutworm moths (*Feltis venerabilis* and *gladiaria*) were attracted only in September.

It is obvious that facts like these will be of great practical assistance to scientific students seeking to collect insects in numbers.

Of all pests the codling moth (*Carpocapsa pomenella*) has displayed the greatest caution in shunning the traps. For one hundred nights Prof. Stedman kept a lantern burning in an apple orchard infested with these insects. The trees were blooming when he first lighted his lantern and his experiment continued throughout the active season of the pest, but he succeeded in catching out of the thousands in the orchard only two individuals. Prof. Garman of the Kentucky Experiment Station and Prof. Troop of the Indiana station conducted similar experiments, but failed to capture a single codling moth.

Dr. Mark V. Slingerland of Cornell states that thirty years' experiments in the United States with trap-lanterns have succeeded in capturing only eleven codling moths.

A scientific horticulturist interested in the subject has suggested that insects unattracted to ordinary flame might be ensnared by colored lights. The fact that in the daytime certain colors are irresistible attractions to various kinds of insects has suggested to the investigator that if scientists could determine just what color scheme would serve as a lure at night, many pests now able to withstand the temptation of common flame might fall a prey to the trap.

Any project that will give support to the trap-lantern method of extermination will be welcomed by horticulturists, who, noting the enormous numbers of insects lured to their death every night, confidently hope that future scientific progress will make it possible to mete out more extended execution to the noxious species that have levied on their crops. For the purpose of widening knowledge on the subject, entomologists and horticulturists will keep their trap-lanterns burning throughout the United States.

The work of securing complete data on the subject is necessarily slow, requiring an infinite amount of detailed research in identifying specimens caught. It has been such a comprehensive task that some of the stations announce that it has been the most costly experiment they have undertaken, on account of the great amount of clerical labor and scientific skill which had to be employed in the preservation and classification of the army of insects hurling themselves into the traps.

BALLOON MEASUREMENTS OF MAMMOTH CAVE'S HEIGHT.

BY DR. HORACE C. HOVEY.

Mammoth Cave is really a congeries of caverns whose walls and floors have broken through into each other. It is excavated from the St. Louis Limestone, overlaid by the Chester Sandstone, and exists in five tiers between the sandstone and the drainage level. While the general openings are in long halls and avenues, now and then widened into spacious chambers, there are occasionally vertical chasms, which are styled "pits" or "domes" according to the point of view. For example, Little Bat Avenue ends in an ugly black hole called the Crevice Pit. Spark's Avenue, on a much lower level, leads to the Mammoth Dome, which opens upward through the Crevice Pit. That is to say, Crevice Pit and Mammoth Dome are identical.

The full history of attempts to measure this vast chasm would fill many columns. The main facts of interest are as follows: Mr. Wilkins, of Lexington, Ky., was the first to make the attempt, in 1812, in the days of saltpeter mining. He tied a lamp to a rope and lowered it 45 feet. But the rope caught fire and the lamp was dropped into an abyss where it remained for thirty years, when found by Matt, the guide, and it is now in the writer's cabinet. A sprightly young negro, who was let down as a kind of animated plummet, to recover the lost lamp, lost his wits instead. When Edmund C. Lee, C.E., in 1835, attempted to make a map of the cave, he sounded the Crevice Pit and touched bottom at the depth of 280 feet. This was for years accepted as correct.

In 1896 the writer, in company with Dr. R. E. Call, undertook to make an exact measurement. Our first attempt succeeded only in explaining Mr. Lee's error. Our plummet lodged on a ledge and the cord continued to be paid out, its own weight sufficing to carry it down till we happened to discover the trick. A block of stone was then substituted for the lighter weight, and when it caught on the ledge it was jerked off again and sent along on its mission. Thus it reached the floor of the Mammoth Dome immediately under the Pit. Allowance was made for stretching, and the cord was measured by a steel tape. Thus we determined the distance from the brink of the Crevice Pit to the foot of the ladder in the Mammoth Dome to be 88 feet. From the ladder to the lowest part of the chasm it was found to be 31 feet vertically; making a total distance of 119 feet. All the great pits in the cave have also been measured, the results appearing in our guide-book.

Until recently no method has been devised for measuring upward into domes otherwise inaccessible. This summer I demonstrated the practicability of such upward measurements by means of small balloons. As it was a novelty in cave work, my attempts were experimental. My first lot of balloons proved a dead failure because they would not stand sufficient inflation. A new set was obtained to order, made of thinner and more elastic rubber. A 50-foot cylinder of hydrogen gas was forwarded from Cincinnati, and a room at the cave hotel was set apart for our experiments. The balloons were readily inflated to a diameter of 10 inches; and when one was released it soared far above the trees, to the delight of the natives who witnessed the performance.

On June 27, 1903, I entered the cave, accompanied by Mrs. Hovey, Mr. W. S. Miller (cave-agent), J. M. Nelson (guide), and my friend, Gerard Fowke. I had looped five balloons in a cluster, so that if one got away the others could be used, and a light sewing-silk was attached as a guy. We easily measured the height of the vestibule just beyond the cascade, finding it to be 26 feet, the daylight enabling us to watch the ascent of the balloons. When we reached the Rotunda, where Audubon Avenue branches from the Main Cave, a room which our tape-line told us was 164 feet in diameter, we found the advantage of having with us a powerful acetylene lamp, whose rays Mr. Fowke turned upon the balloons as I let the silk slip through my fingers. From floor to ceiling we found to be exactly 40 feet. Our next measurement was at the Church, at the junction of the Main Cave and Archibald Avenue, finding the height to be 49 feet 6 inches. In each case we measured from the floor to the top of the group of balloons. Our scheme worked well.

Thus encouraged, we next attempted that vast subterranean temple, named for an early owner Gorin's Dome. Dr. Call had already measured the depth from the bridge to the bottom as 119 feet—identical with the depth of the Crevice Pit to the bottom of Mammoth Dome. The total height from floor to apex was estimated at 159 feet; but we hoped by ballooning to substitute exactness for guesswork. By means of the acetylene lamp, and special magnesium lights brought for the purpose, the gigantic dome was illumined as perhaps never before. Its mighty alabaster folds swept around us like massive curtains; and the absolute silence was broken only by the music of the pattering drops falling from the pendant stalactites. When the cluster of gaily tinted balloons was sent upward on its mission the sight was extremely pretty. They mounted well for two-thirds of the way, and then were caught by a current of air and wafted from side to side through the sigmoid curves of the great abyss. We drew them back to us, and dried their moistened surface, and tried again and again, only to be baffled by those mysterious atmospheric currents that made the gay globes flutter hither and thither, like willful creatures.

A fatiguing tramp carried us through the Main Cave to the so-called "Chief City," which is not a dome-pit but a vast enlargement of the general passageway. Here again we were doomed to a failure that should have been guarded against. The uniform cave temperature is 54 deg. F., which would, of course, cause some shrinkage of the rubber bags inflated amid a sunny June day outside. The moisture in the domes had also played its part in the same way. So that the balloons were considerably less in size than at starting. We clustered our lamps together, and ignited oiled rags, and by other means tried to coax our messengers to do their duty; but in vain.

Passing over various subsequent experiments, we made a special test of the Mammoth Dome, where our balloons worked perfectly. First we measured from the foot of the waterfall to the level of the ladder, and thence to the highest part of the dome visible; making it exactly 119 feet 6 inches. Then going around by Little Bat Avenue, we measured the height of the ceiling at its junction with Audubon Avenue; also as well as we could the small domes near the Crevice Pit. Our conclusion was that about 35 feet would have to be added to the above in order to get the total altitude of the chasm, namely 154 feet 6 inches. This result, it will be perceived, nearly coincided with the previous measurements made in 1896 by entirely different methods.

Taken as a whole, our experimenting with cave-balloons was successful, and demonstrates the utility of that method of measuring heights not otherwise accessible. We would remark, however, that small specially made hot-air balloons might be better than those inflated by hydrogen gas, for the reason that their fireballs could be made large enough to defy sprinkling from cascades.

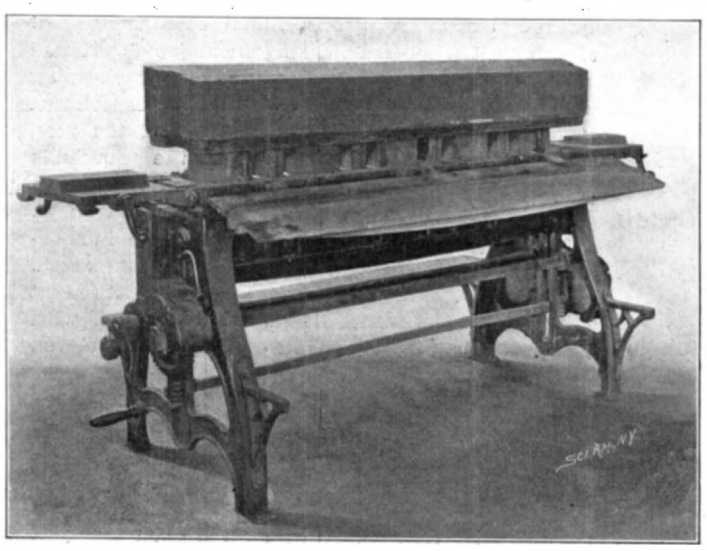
CONCRETE HOUSE BUILDING.

Not the least striking sight that greets the eye of the traveler in Mexico and the southwestern part of the United States is the singular architecture of the country through which he is journeying. Peculiar houses are met on every hand—low, rambling structures, many of them a century old and more, apparently hewn out of one solid mass. Soon enough the traveler discovers that the material of which these old and sturdy houses are built is not stone, but sun-dried bricks of clay, which have successfully resisted both the torrid heat of the dry season and the heavy showers of the rainy season. The lack of stone and wood compelled the inhabitants to construct their dwellings of a building material which was not only cheap, but also easily procured.

That the adobe house of the Southwest has not been introduced in the East is primarily due to the fact that kiln-dried brick, stone, and wood were too cheap, not because they were intrinsically better. Artificial stone has been employed to some extent; but the difficulty of its manufacture, coupled with its cost, has not raised it to the rank of a very formidable rival of brick and natural stone. Of late years, however, concrete has come gradually to the fore as a building material, which possesses all the merits of the most durable stone, and which, besides, has the merit of greater cheapness. In various parts of the country there may now be seen dwellings, factories, and workshops built of concrete, which for all the world look like masonry. By far the greater number of these structures have been erected after a simple and ingenious system invented by Mr. Harmon S. Palmer, of Washington, D. C. The result has been the introduction of a new type of dwelling very much cheaper than the ordinary brick structure and architecturally immeasurably superior. The adobe house of the Southwest has developed into a building constructed of a concrete, artificial stone, made in accordance with long-established principles of engineering.

Structures built on the Palmer plan are not simply piles of solid concrete, fashioned into walls and windows. The material is formed into blocks of any desired size, ornamented or unornamented, and hollowed within. Thus it happens that the concrete blocks have all the merits of the hollow brick. The house of which they are built is cool in summer and warm in winter, for the air-jacket formed by the walls of hollow blocks acts as a perfect insulator.

Given good, hollow concrete blocks and the problem of erecting a house cheaply and quickly is easily enough solved. The true difficulty is to be found in the making of the blocks. No doubt concrete would have been used long ago had it been possible to employ a portable machine capable of forming blocks of all desired sizes. It is just such a machine that Mr. Palmer has invented; and it is due entirely to this invention that the concrete building has become possible. In its construction and operation, this machine is simple enough. Upon a substantial base frame is mounted a metal mold, one side and one end of which can be swung down. The mold is provided with a false bottom, which can be raised and lowered to any desired height, and which is provided with openings to receive blocks secured to the true bottom. The blocks serve the purpose of forming the hollows in the concrete product. The stationary side of the mold can be formed with any design or pattern. In making a concrete block, the false bottom is raised to such a height that the finished block will have the necessary depth, and the swinging side and end sections are clamped tightly into position. A hopper is placed over the mold. A mixture of sand and cement in the proportion of about 5 to 1 with water, which is about as damp as moist earth, is then shoveled into the hopper and tamped down into the mold. The concrete block thus formed can be easily removed by throwing down the swinging side and end of the mold, and lifting the block out of the machine by means of a special carrier. The block can then be transported to any desired place and left to dry. In order to form window-sills the mold is provided with shoulders at about the middle of each end section, so that the concrete block is formed with a groove. The tongues of correspondingly-formed blocks fit into these grooves, so that a very solid and rigid course of concrete blocks is produced. The fastening of the floor beams in place is effected in a manner no less ingenious. By cutting away a rectangular opening into the side of the block, the suitably formed end of the floor beam can be inserted, the wood and concrete being so firmly held together that there is no possibility of dislocation. The joints can be filled with cement if need be, to add to the security.

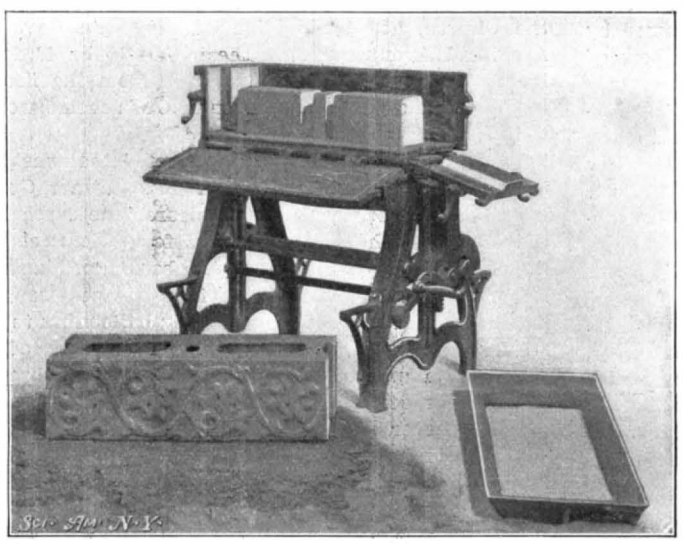


The Sides and Ends of the Machine Swung Down to Permit the Removal of the Finished Concrete Block.

A house built of these hollowed concrete blocks in external appearance is as handsome as any structure built of the finest sandstone. Indeed, even a close inspection often fails to reveal the material of which the house is built. We doubt whether any of our readers would be able to tell of what material the half-completed dwelling pictured in one of our illustrations is built; and yet the entire building was erected with concrete blocks molded in the machines described.

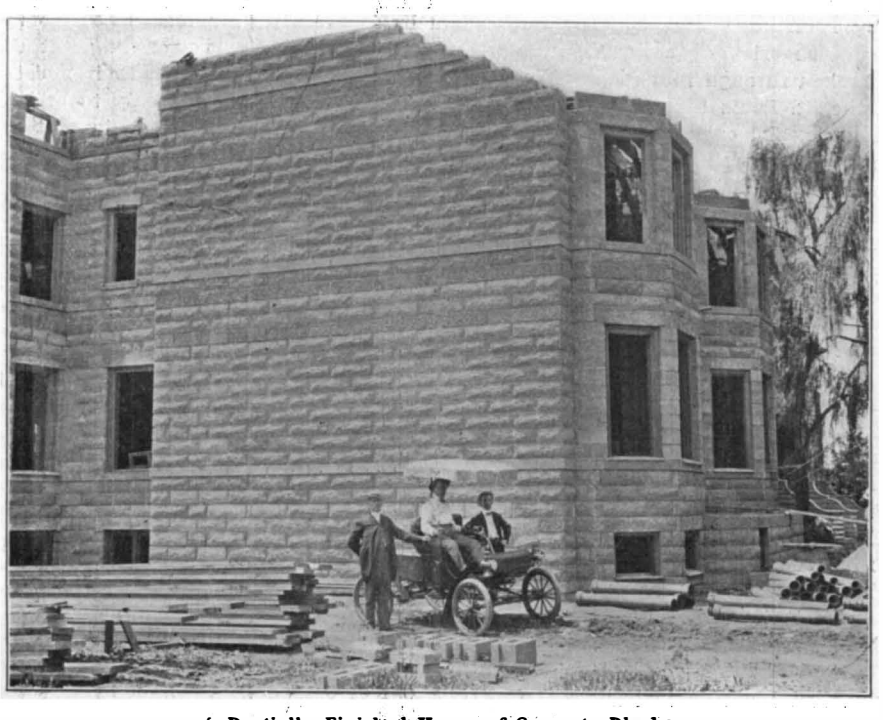
It is one of the peculiarities of this system of construction that the machine which forms the essential element is so designed that blocks of any desired proportions can be molded. Thus, it becomes possible to use but a single machine for the molding of blocks to be used in many different parts of a building in course of erection. Indeed, it may safely be said that the success of this method of building depends upon the adaptability of the machine for making more than one size of blocks. It can be easily understood that little if anything would be gained if it were necessary to use a separate machine for each particular size of concrete block which might be needed.

Our illustrations sufficiently show the possibilities

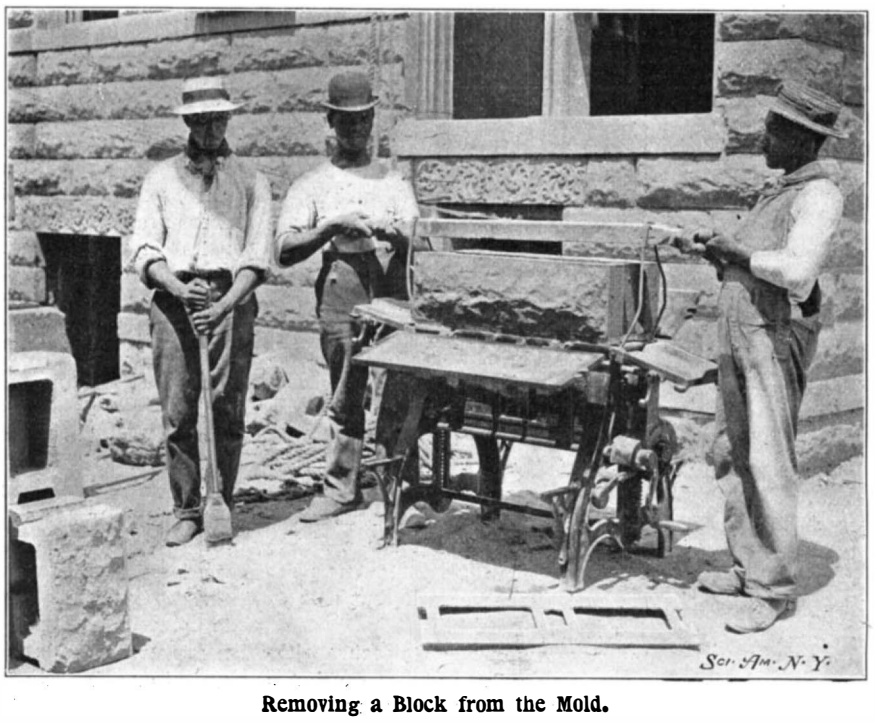


The Molding Machine and One of Its Products.

An Open-Air Concrete Block Plant.



A Partially Finished House of Concrete Blocks.



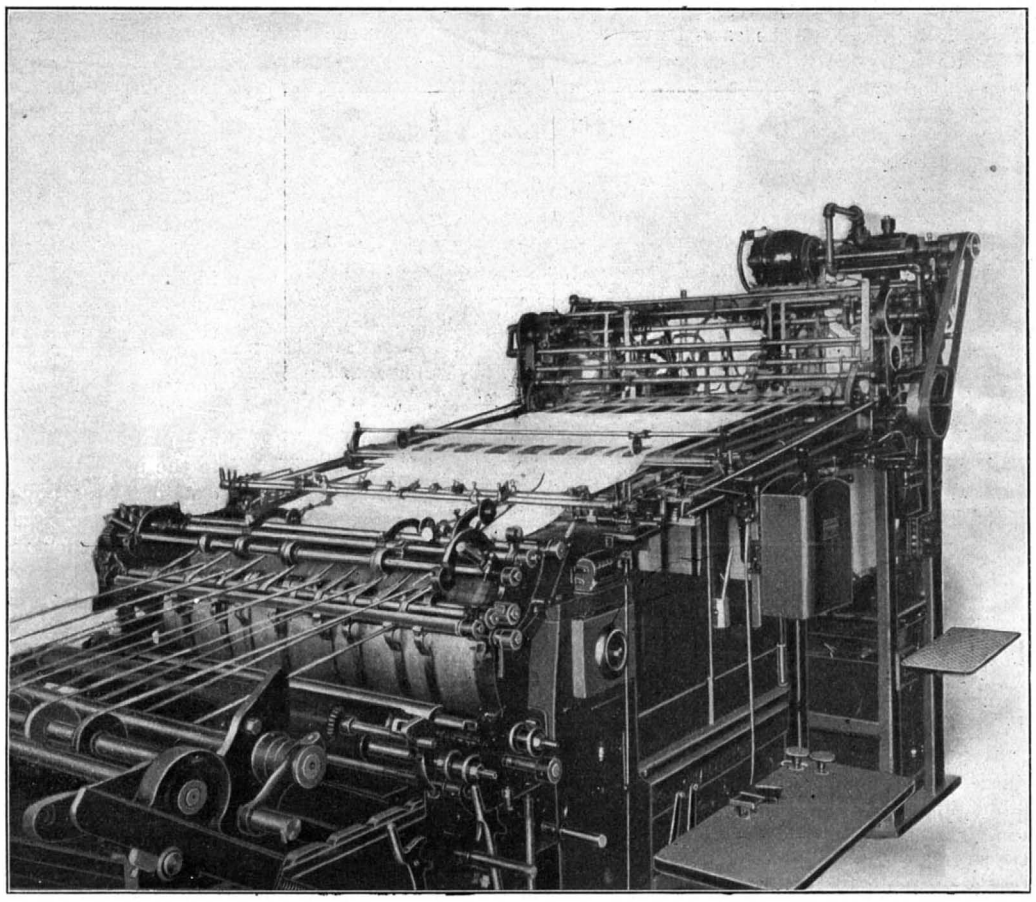
Removing a Block from the Mold.

of molding blocks of different design. In the building illustrated, the blocks were made to simulate with remarkable accuracy the appearance of cut stone. It is possible, however, to produce blocks in which complicated patterns are cast with an effect that would seem attainable only by the deft hand of a skilled stone-carver.

AUTOMATIC PAPER-FEEDERS FOR PRINTING MACHINERY.

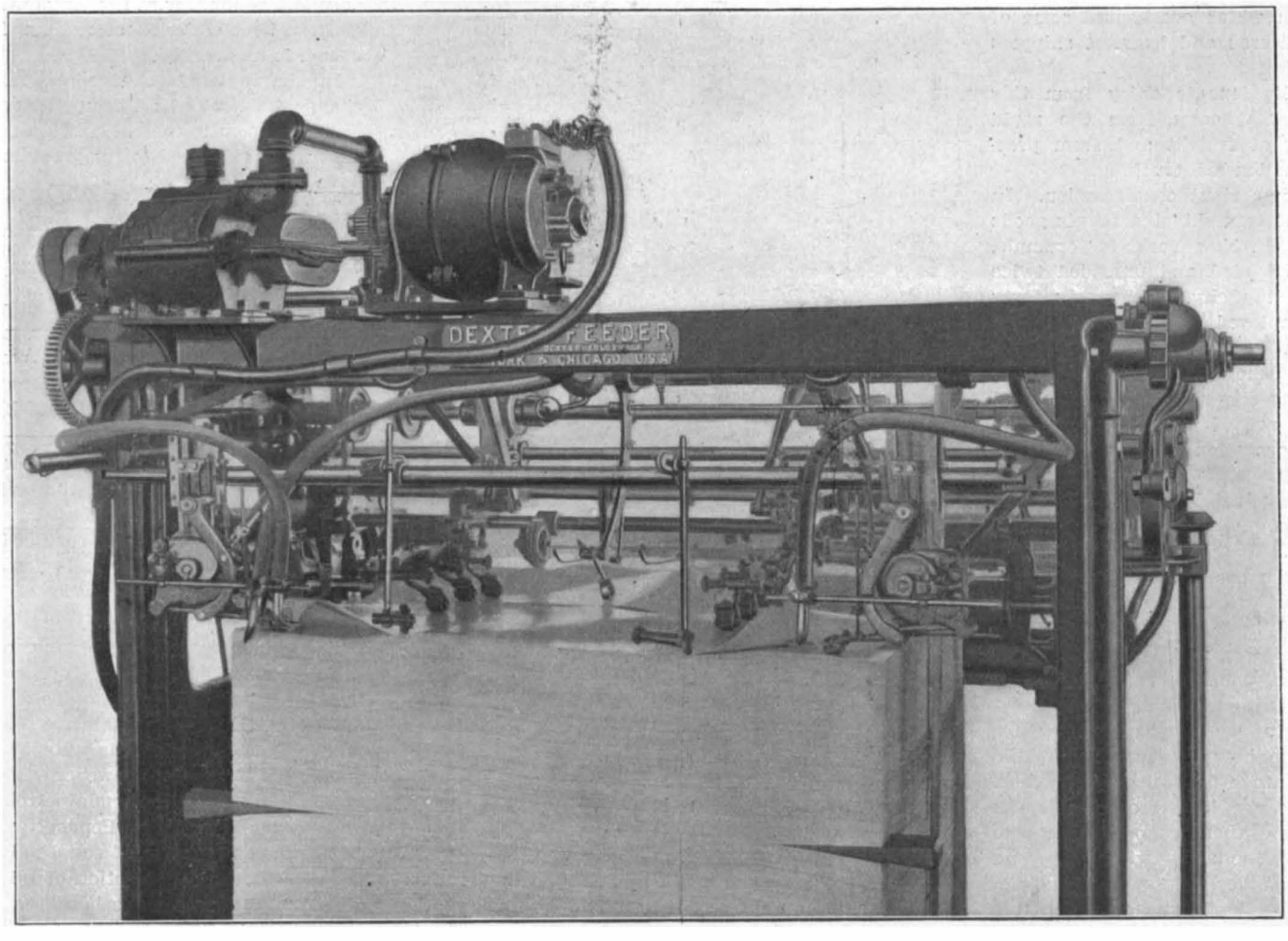
In the last few years the development of modern printing machinery has been phenomenal. Larger and faster presses, labor-saving devices for feeding, folding, cutting, covering, and case-making have reduced the cost of labor charges to a remarkable degree, and the quality of the product has steadily gained. Presses traveling at a high rate of speed were built, and this speed was increased until it finally got the better of the feeder and opened a field for the automatic supply of paper to the press, thus increasing output from 20 to 40 per cent, without mentioning other advantages, such as a saving in spoilage of paper and perfect registry. Printers, while strongly organized, do not look upon labor-saving devices as an incitation to strikes for with every march of improvement wages are increased. Still it must be admitted that the paper-feeder has minimized the liability of strikes among press-feeders. The continuous use of the press adds greatly to the increase in the output. The feeders can be loaded with paper at the regular hours and the capacity of the paper trucks is very large, 20,000 sheets not being unusual. The paper-feeder is not limited in application to the printing press. It is applied to folding machines and ruling machines. The paper-feeder must not alone supply paper to the grippers of the cylinder, but must automatically control the action of the press during the whole operation. Otherwise there will be little utility in the machine. In brief, the principle of the automatic paper-feeder is as follows: The paper is placed in a pile upon a movable elevator which rises automatically as required. When the operation is started, the corners of the paper are slightly raised, the buckling fingers buckle the paper, compressed air is blown toward the center of the sheet to separate it, and the sheet is then advanced through a caliper which measures the thickness of the sheet. The calipers insure absolute accuracy.

We will now take up the operation of the machine in detail. The feeder is run either by the press itself, or preferably by an independent motor, electricity being usually employed. The feeders which we illustrate are of the independent electrically-driven type, and are made by the Dexter Folder Company, of New York city and Pearl River, N. Y. Power is required to work the buckling attachments, the sheet-advancing devices, the tripping mechanism, and to run the blower. The total power employed is slight, being only ¼ to ½ horse power. Compressed air is only used as an adjunct, its function being to loosen the top sheet, after the buckling fingers have raised the corners of the sheet, which causes it to move readily on a thin skin of air. There are two bucklers, one at each side of the feeder. These bucklers are adjustable to the pile. The driving power is applied through a telescopic knuckle-jointed shaft which readily accommodates itself to the various positions of the buckler. The buckling finger will move parallel with the edge of the pile, or it may be set diagonally, which best suits the paper being fed. A cam actuates a buckling finger or roll through the medium of a connecting rod. The action is very much the same as in turning the leaves of a book with the aid of a moistened thumb. A fixed finger to oppose the action of the roller helps to cause the sheet to be thoroughly separated, working in conjunction with the air blast. It will be noticed that there are three pieces of mechanism visible directly behind the buckling attachments. These are the two sheet-advancing carriages and the pile-elevating governor. The principle of feeding involved is very simple. All of the sheets, except one which is to be fed, are held back by a foot on the buckling attachment. The two sheet-advancing carriages which are on either side of the pile-elevating governor carry push fingers which travel in two distinct planes. On the forward stroke they are dropped into contact with the pile. They then advance the sheet forward on to the movable tapes, which carry it to the impression cylinder. On the backward stroke they are elevated above the pile, leaving a sheet free to be taken forward. It may well be asked what is to prevent the automatic feeding of two sheets owing to various causes, such as two sheets sticking together. This is prevented by an automatic sheet-calipering attachment which is located just beyond the sheet-advancing carriages. In brief, it consists of rollers which are very accurately adjusted; a single sheet passing between them would not cause friction enough to revolve the upper roller; but if more than one sheet enters between the rollers, the extra thickness will rotate the upper roller *B*, causing the pin *C* to tilt the pendulum *D* so that its upper end will be moved from another arm *E*, which actuates a clutch, stopping the machine. This automatic stop of the feeder takes place before the sheet is advanced on the pile more than 6 inches. The caliper does not stop the press; but it stops the feeder. The press does not stop until all the sheets are printed that have previously passed beyond the caliper. The sheets are quickly run down again from the feeder to the drop guides of the press by power before the press is started. This saves the spoiling of sheets, and it also prevents the possibility of blank sheets getting into a pile at the fyboard. The small roller, which will be noticed as pressing on the sheet in the center, is the pile-elevating governor which automatically regulates the height of the pile of the sheets. Through the medium of a connecting rod it controls a locking finger. The pile will be fed up until the lifting of the wheel which goes up with the pile causes the locking finger to throw out of gear the elevating mechanism. This device is so sensitive that the height of the pile will not vary the thickness of one-sixteenth of an inch.



Paper Feeder Applied to a Cylinder Press.

The sheet having been fed forward by the fingers of the sheet-advancing carriage and having been calipered, is allowed to pass on its way and is moved down to the press by means of tapes. But the feeder is not finished with the sheet until it has been actually taken by the impression cylinder. In all probability the sheet has been fed forward with such precision that the registry is most accurate. Now, no chances are taken, side registering grippers being provided, which give absolutely perfect registry, which is so necessary in color work. In brief, the side register gripper consists of clamps which, in case of any inaccuracy, seize the sheet and turn it to the proper position. The sheet is now advanced toward the cylinder, the whole operation, of course, being a continuous one, one sheet following immediately the other one. Directly over the impression cylinder is a device intended to control the tripping or skipping of the impression. In case a sheet catches in delivering from the impression cylinder, the press is in-



Paper Feeder in Operation.

AUTOMATIC PAPER-FEEDER FOR PRINTING MACHINERY.

stantly stopped by means of a combined driving and tripping box which varies according to whether electrical or mechanical power is used. This tripping box is placed on the floor back of the press flywheel, and underneath the platform at the side of the press. Power is transmitted to feeder from press or motor through a knuckle-jointed shaft for either motor or belt-driven presses. All the parts for shifting the belt, applying the brake and tripping the impression are in this trip box and they are all controlled automatically by the sheet which is being fed. From our description it will be seen that the machine may stop feeding, the impression may be tripped, or the press stopped, depending on the nature of the difficulty. The adjustments can be made so accurately that even tissue paper can be fed with as much certainty of success as a heavy paper. At the Scribner Press, where our photographs of the feeding machines were taken, the finest three-color work is printed at a high rate of speed, with the aid of these feeders, and in four-color work they are particularly economical. These feeders are also very useful in binderies, the mechanism, of course, being slightly varied to allow of the difference between printing presses and folding or ruling machines. The paper-feeder is a machine which is not an invention, but a series of inventions.

Cupples Station—A Combined Freight Depot and Business Block.

BY EARL MAYO.

The genius for organization and for the economy which results from operating on the largest possible scale, have been remarked by observant foreign visitors as characteristic of Americans. This development has been carried much further toward perfection in the field of production than in that of distribution. There is, however, one institution in the United States in which the wholesale handling, distributing, and transshipment of goods has been worked out on a scale of elaborateness and with a perfection of detail unequaled by any similar institution in the world. This is Cupples Station.

The World's Fair in St. Louis next year will give an opportunity to wholesale merchants and organizations of business men to visit this unique establishment, which they will find of great instructive interest. It is in a measure a public institution, for, while founded as a private enterprise by Mr. Samuel Cupples and Mr. Robert S. Brookings, and developed by them into a very successful business, they gave it outright to Washington University in 1900, and it is now administered in the interests of the University. At the time of its transfer it was valued at $3,000,000, which was considered a very conservative estimate.

Cupples Station is in brief a mammoth freight depot, a distributing station through which passes a large part of the business traffic between the Southwest and the rest of the country, and a clearing house for the wholesale trade of St. Louis and its tributary territory. It consists of a series of eight immense brick structures, seven stories in height, grouped close together, in which are housed some of the largest wholesale concerns and heaviest shippers in the country.

The advantages that its tenants enjoy from this concentration are those that come from the rapid and economical handling of freight and from practically the entire elimination of trucking.

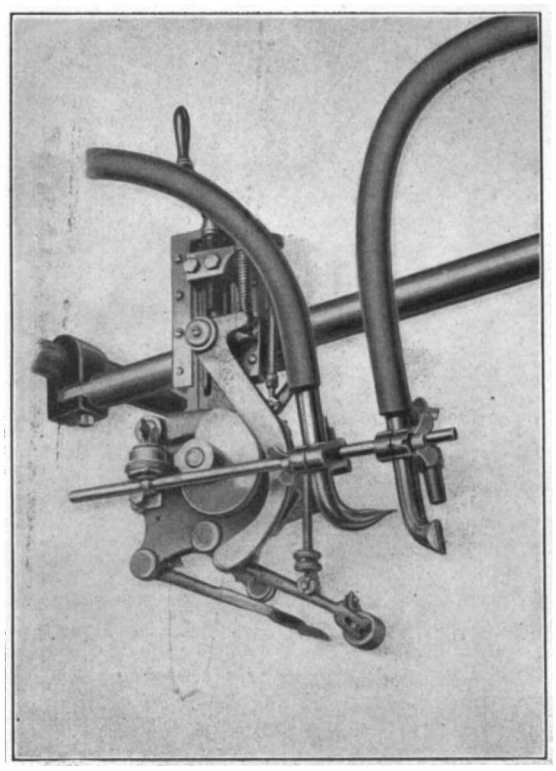
The latter is a most important consideration. In nearly all other important transshipping points goods have to be carted twice. In New York, for example, all merchandise must be loaded and unloaded twice in entering and leaving the city, and nearly forty thousand trucks are employed in this work. By the system in operation at Cupples Station, nine-tenths of this carting is done away with.

The conformation of the city and the arrangement of its terminal facilities are of material importance in making possible the operation of this plan. All the railways entering St. Louis are connected by what is known as the Terminal Railway, so that all the tracks over which freight is moved are brought together into one group.

Close beside these tracks are the buildings which constitute Cupples Station, with spurs and switches running underneath all of them. The loaded cars are run directly into the buildings; the freight is discharged at the platforms upon very heavy trucks capable of moving 4,000 pounds each; immense hydraulic lifts elevate it to the particular floor for which it is destined; from here it is wheeled to the storerooms of the firms to which it is consigned. Similarly, outgoing goods are loaded on the trucks at the shipper's door, and thence moved direct to the car. All cartage is done away with except on local business destined to other points in the city.

The saving in time, labor, and expense which this arrangement makes possible is evident from the mere statement of the facts. But the most noteworthy feature of the system, and the one on which its success chiefly depends, is the method by which the shipping transactions of all the concerns in Cupples Station are co-ordinated, so that they are carried on practically as though they were the operations of a single organization.

All the loading, unloading, and handling of goods is done, not by the shippers and receivers, but by the employes of the station management. They unload the cars, move the trucks, and deliver the goods

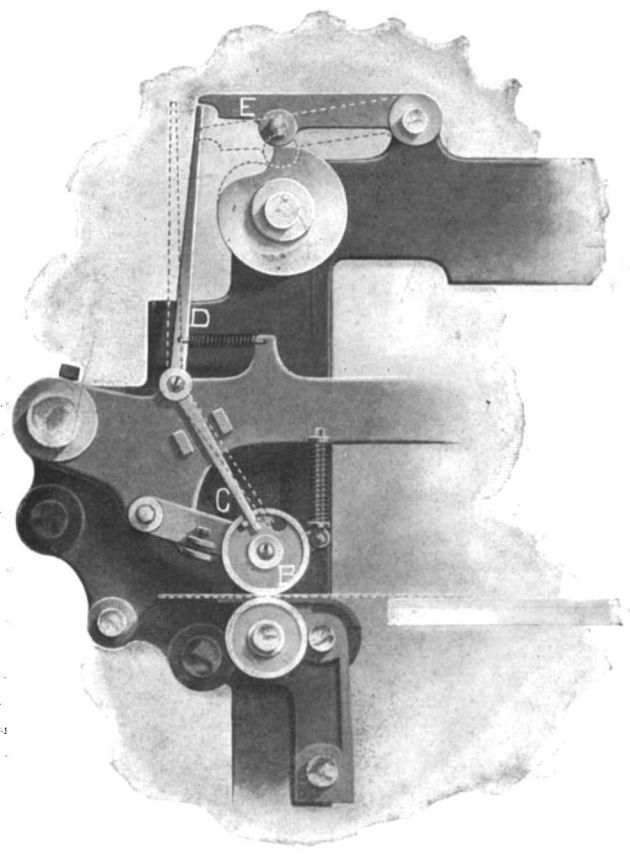


Buckler and Air Hose.

at the consignee's door. When a firm is shipping freight, it need only place it on the truck. It is moved to the cars and placed on board by the station employes, who also attend to the bills of lading and all such matters. The expense of this work is assessed *pro rata* on the different tenants according to the extent of their shipments.

This makes possible further economies in the loading and movement of cars. Cupples Station receives and ships about a thousand tons of merchandise a day, which, according to Dr. Taussig, president of the Terminal Association, is more than is handled by any railway freight station in the country. Notwithstanding the great volume of business, everything moves in the most systematic and orderly manner.

The cars containing inbound goods are delivered alongside the platforms during the night by the different railways. Early in the morning the work of unloading begins, and by nine o'clock in the morning



Detail of Paper Caliper.

AUTOMATIC PAPER-FEEDER FOR PRINTING MACHINERY.

most of the goods are delivered. As many as sixty cars have been unloaded within two hours, and the contents distributed to the various storerooms in which they belong.

The incoming goods being thus disposed of in the morning, the remainder of the day is devoted to the handling of outbound freight. The loaded trucks are rolled out of the various stores on the upper or shipping truckways into the great freight-receiving room. Here the goods are received; bills of lading are made out; the packages are assorted for station order loading, and go out by trains over the various roads during the day. Each railway has a schedule hour for pulling its train, and the various firms assort their orders and get out their goods to conform as closely as possible to these schedules. One of the beauties of the system is that a single package of merchandise can be shipped from the doors of any of the offices to any point with equal facility as a carload lot, and without the delay, expense, and possibilities of damage that exist where cartage is necessary.

The station is a very beehive of activity during business hours, when its two thousand employes, its forty-eight immense hydraulic elevators, and its four thousand trucks are all in action. Cars are unloaded almost in less time than the telling takes, and their contents are whisked away to a dozen different destinations, all under one roof. The interior arrangements are planned with the greatest care, and space is used to the utmost possible advantage. The space is rented out in floors; and while the tenants are able to conduct their business at a saving over the expense they would be under in separate and scattered buildings, the station itself pays handsome dividends on the investments it represents.

The different buildings of the Cupples group occupy an area of over thirty acres, and include a floor space of a million and a half square feet. The thirty tenants represent an invested capital of more than $25,000,000 and an annual business of over $75,000,000. The vast interests represented increase the efficiency of the station's work, which depends for its success upon the handling of a large volume of business.

Cupples Station represents to its tenants convenience and facility in shipments, economies in labor, in the operation of elevators and trucks, economies through the elimination of the expense of drayage, through the saving of waste and damage to goods in handling, and it also represents a saving in the cost of light, heat, and steam, owing to the location on the premises of an immense electric-lighting and steam-heating plant operated by he company. The whole enterprise is the most complete development of a typically American idea.

Another Radium Phenomenon.

Prof. Curie has communicated to the French Physical Society still another remarkable property of radium. But a few months ago scientific men shook their heads when it was proclaimed that the new substance possessed the property of maintaining a temperature higher than that of the surrounding atmosphere. Prof. Curie now announces the amazing fact that the change in the rate of heat emission of radium within the comparatively short distance of absolute zero is exactly in the opposite direction to what might be expected in view of the effect of low temperatures on ordinary chemical action, for at the temperature of liquid hydrogen the heat emission of radium, instead of being reduced, is augmented.

In simple language, the substance which does not change its heat at all temperatures, from that of an ordinary room to that of liquid air, gives out a greater heat when subjected to the greatest cold that scientists have yet reached.

These experiments with liquid hydrogen have led to the curious discovery that freshly prepared salt or solution of radium has a comparatively feeble power of giving off heat at all temperatures, but the power steadily increases for about a month, when it reaches its maximum activity, which it then maintains apparently indefinitely. These remarkable results have failed to throw any light upon the process whereby radium maintains a constant emission of heat radio-activity.

Vesuvius in Eruption.

Dispatches published in the daily press from the Observatory of Vesuvius state that explosions have developed new fissures in the cone of the volcano's crater. Through these fissures lava is flowing in two streams, the smaller one to the southeast, and the other and more important to the north.

For many months the oil consumption of the world has exceeded the production, for which reason financiers and merchants have feared a possible exhaustion of the oil fields. Reports published in the Manual of Statistics, however, show an extensive decrease in the stock of crude petroleum in the greatest of all American fields, Pennsylvania, within the last two years and figures of equal authority indicate that for months the consumption of oil from Pennsylvania and West Virginia wells has been very largely in excess of production. The stock of crude Pennsylvania petroleum above ground in December, 1900, was 13,174,717 barrels, while in December, 1902, the amount thus stored was only 5,699,127 barrels.

Correspondence.

Phonogram.

To the Editor of the SCIENTIFIC AMERICAN:

Noticing the propositions of a name for the messages by telephone I am led to offer one. My choice would be "phonogram." It seems to me that it would be appropriate and expressive.

Penfield, Pa., July 20. ALLEN ROSENKRANS.

The First Bear-Trap Dam.

To the Editor of the SCIENTIFIC AMERICAN:

William Gilbert Irwin, in his interesting article entitled "Waterway Improvement on the Ohio," while referring to the "bear-trap dam," says: "All the dams in operation and building on the Ohio are of the movable type, the Davis Island dam at Pittsburg, which was completed in 1885, being the first dam of that type ever built in this country."

This is an error, in correcting which I will give you a few points in the early history of coal mining in Pennsylvania. The Lehigh Coal Company, after several unsuccessful attempts to get their coal to market, leased, early in 1818, 10,000 acres near Mauch Chunk, Pa., to Josiah White and his two partners, for twenty years, for *one ear of corn a year*, if demanded, and from and after three years to send to Philadelphia at least 40,000 bushels of coal per annum, on their own account, so as to be sure of introducing it into the market.

The lessees began immediately to improve the Lehigh River by the construction of wing dams, etc., for the purpose of deepening the water in the channel and making it navigable for coal barges. But early in the following year they discovered that they had not sufficient water for their purposes. Josiah White, in his autobiography, says: "We found the natural flow of the water in the Lehigh was insufficient, the water subsiding much below the mark we had made, on the best information we were able to procure from those on the river who professed to know all about it, and we were obliged to make a great experiment to obtain the water by artificial freshets; and if we failed in this, our whole work would be exploded and have to be abandoned. I devoted myself for several weeks to form a plan of sluice that would answer, and be cheaply made, and safe at all stages of the water. I succeeded in producing the lock and sluice called the 'bear-trap,' a name the workmen gave it while we were experimenting with it on Mauch Chunk Creek, to elude the curiosity of persons who teased them with inquiries as to what we were making. We put up about twelve of the locks and dams in 1819, and I took out a patent for them in the twelfth month, 1819."

In 1873 three of these dams were still in use on the upper Lehigh between White Haven and Stoddartsville.

JOSEPH J. WHITE.

New Lisbon, N. J., August 18, 1903.

Windmills in India.

To the Editor of the SCIENTIFIC AMERICAN:

Any one who has lived in India, where the winds are sufficiently strong to warrant their erection, recognizes that India in the near future will prove an excellent market for windmills.

Mr. Chatterton's report shows that the government is awake and is accumulating facts as to the usefulness of the windmill for purposes of irrigation, by most careful and prolonged experiments. Undoubtedly there is here a wide field for American enterprise.

The people in India must be educated and made aware of the utility of the windmill, and when once convinced, they will undoubtedly purchase liberally. The Europeans will be the forerunners in their general introduction, as the natives are extremely conservative and unwilling to make an outlay of money unless convinced of speedy returns.

The field should be most carefully studied by experts who should then adapt the windmill to best meet the needs.

The addition of a "second pump" mentioned by Mr. Chatterton should receive careful attention. Companies competing for the market must be prepared to supply a number of varieties and sizes depending upon the height the water that must be raised. For example, in the part of the country where I am located, the water would only have to be raised 25 feet at the most for irrigating purposes, whereas further from the coast it would be considerably more.

A matter touched upon in the report which should receive the most careful attention is that of "breakages." Europeans who have not lived in India little realize the ignorance of the natives when dealing with home-made devices and their unwillingness to adapt themselves to new conditions. They are not "Jacks of all trades," but are bound down by caste and custom to be "Jacks of one or no trade." There are places where it would be necessary to send hundreds of miles to get a thread cut on a bolt when at home it can be done "around the corner." Because of this ignorance, the employing of an experienced fitter for each windmill is necessary.

When striving to open markets in the East, manufacturers must provide: (1) The very best material; (2) the simplest mechanism; (3) the highest development of skilled workmanship, and (4) the counterparts of all portions which are in the least liable to get out of order, together with (5) a clear outline of instructions. Then only will the people be prepared to purchase, and when once convinced of an article's usefulness, they are prepared to pay liberally.

Windmills for India should be constructed wholly of iron or steel. Wood is quickly destroyed by white ants and other insects, or, owing to the terrific power of the rays of the sun, will become weakened and soon have to be replaced.

Any successful water-raising apparatus is sure to command a wide market in India, whether it be the windmill, the sun motor, or an engine. First of all people must be educated. The erection of windmills, etc., at the various centers in India as practical illustrations is most desirable. Literature has its place, but is not of very great importance.

(Rev.) WALTER T. SCUDDER.

Tindivanam, Madras Presidency, India, July 13.

[Lack of space prevents us from publishing the report referred to. Our correspondent's letter is, however, sufficiently clear to show the requirements that must be met in India.—ED.]

The Langley Airship.

Prof. Langley has issued the following statement:

To the Press:

The present experiments being made in mechanical flight have been carried on partly with funds provided by the Board of Ordnance and Fortifications, and partly from private sources, and from a special endowment of the Smithsonian Institution. The experiments are carried on with the approval of the board of regents of the Smithsonian Institution.

The public's interest in them may lead to an unfounded expectation as to their immediate results, without an explanation, which is here briefly given.

These trials, with some already conducted with steam driven flying machines, are believed to be the first in the history of invention where bodies far heavier than the air itself have been sustained in the air for more than a few seconds by purely mechanical means.

In my previous trials success has only been reached after initial failures, which alone have taught the way to it, and I know no reason why prospective trials should be an exception.

It is possible, rather than probable, that it may be otherwise now, but judging from the light of past experience it is to be regretted that the enforced publicity which has been given to these initial experiments, which are essentially experiments, and nothing else, may lead to quite unfounded expectations.

It is the practice of all scientific men, indeed, of all prudent men, not to make public the results of their work till these are certain. This consideration, and not any desire to withhold from the public matters in which the public is interested, has dictated the policy thus far pursued here. The fullest publicity consistent with the national interest (since these recent experiments have for their object the development of a machine for war purposes) will be given to this work when it reaches a stage which warrants publication.

S. P. LANGLEY.

Smithsonian Institution, August 19.

The Current Supplement.

The current SUPPLEMENT, No. 1443, opens with a fully illustrated article describing a great California seed farm. Leigh Page presents a *resumé* of the traces thus far discovered of the habitability of Mars. An article on the mechanical sorting of postal packages tells much that is interesting of French methods. Prof. F. C. Robinson discusses the new views of the constitution of matter. Irwin S. Sperry describes how a black color on bronze can be produced. Another installment on the Serpollet steam automobile is presented. Among the minor articles may be mentioned those entitled "The Nernst Incandescent Lamp," "The Roman Foot in Measuring," "Proportions in Architecture," "Mechanical Stokers," "A Botanical Exploration of Cuba," and "Inducing Character of Radium."

Observation of Brooks's Comet.

A telegram has been received at the Harvard College Observatory from Prof. W. W. Campbell at Lick Observatory stating that Brooks's periodical comet has been observed on its return by Aitken on August 18, 8.50.0 G. M. T. in R. A. 21h. 02m. 50.2s. Dec. —27 deg. .04 min. 9 sec. Also the spectrum of Nova Geminorum was observed by Curtiss August 17 and found to be of the nebular type.

The "Cave of Giants" is the name which has been given to a new mammoth cave discovered in southeastern California in the heart of the Providence Mountains. The cave was discovered by George L. Berg, to whom its existence was revealed by a native Indian who lives on the west slope of the range.

Engineering Notes.

The North Eastern Railway Company has now decided to establish a regular motor car service on the old Bridlington coaching highway between Beverley and several of the outlying villages as far as Beeford, distance 13 miles. The motor cars will provide accommodation for sixteen passengers, with half a ton of luggage on the roof.

According to an English expert the supply of coal yet remaining to be mined in the United Kingdom amounts to 80,684,000,000 tons, which, at the present rate of mining, would last 370 years. The same authority gives the total output of the world in 1900 as 767,636,204 tons, of which Great Britain produced 229,000,000 tons, or 30 per cent, and the United States 245,000,000 tons, leaving a balance of about 35 per cent for the rest of the world.

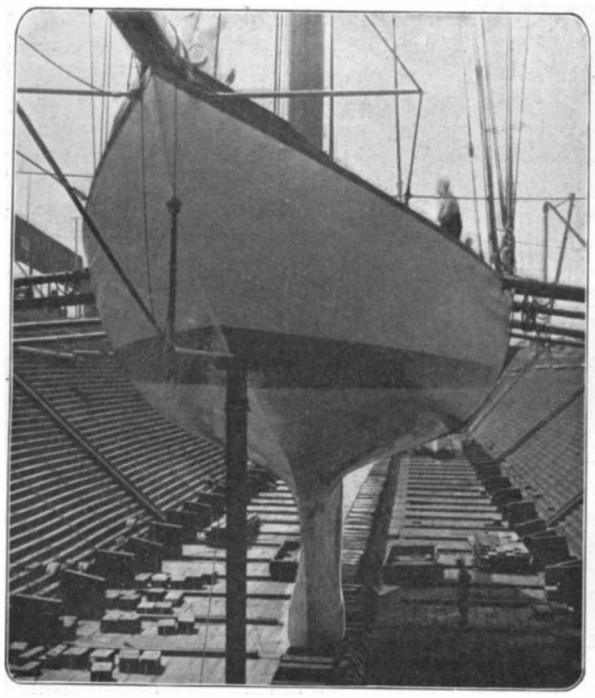
In order to facilitate and accelerate railroad traffic through the Severn Tunnel, which is 4 miles 600 yards in length, a system of electrical automatic signaling is to be installed so that a train will be able to enter the tunnel while another is already progressing through in front. Under the present block system arrangements a train cannot enter the tunnel until the preceding one has emerged from the other end, thus entailing several minutes' delay to the waiting train. For the purpose of signaling the tunnel is to be divided into sections of 1,200 yards. Notwithstanding the fact that a powerful fan extracts 447,000 cubic feet of air per minute from the tunnel, the atmospheric conditions are not suitable for the employment of simply the usual semaphore signals at the sides of the track. Therefore, to insure perfect safety to the trains, the semaphore signals will be supplemented by "repeat" signals indicated in the cab of each locomotive before the eyes of the engineer.

A French locomotive on the De Glehn four-cylinder compound system is to be tried on the Pennsylvania Railroad. Engines of this system, of the eight-wheel and Atlantic types, are extensively used on the principal French railways for fast and heavy passenger service, and one is now being built for the Great Western Railway of England. These engines have two outside high-pressure cylinders driving the rear pair of driving wheels, and two inside low-pressure cylinders driving the crank axle of the front pair of driving wheels. An engine of a somewhat similar design was built about a year ago for the Plant System of railways in Florida by the Baldwin Locomotive Works, but in this engine the four cylinders all drove the first driving axle. The French engine for the Pennsylvania Railroad will be delivered next year, and after some experimental service will be sent to the St. Louis Exhibition as a part of the railway company's exhibit. Eventually it will be put in regular service.—Engineering News.

The inaugural address of Mr. J. C. Henshaw at the opening meeting of the new session of the London Institute of Civil Engineers dealt with the world's supply of timber. Engineers, he remarked, could not do without timber, and it was worth while considering whether the supply of that material was likely to continue to be equal to the demand. It was calculated that the number of timber sleepers on the railways of the whole world did not fall far short of 1,495,000,000 and a low estimate of their value was $900,000,000. This alone constituted a serious drain on the timber supplies of the world. The president next reviewed the measures which had been taken in other countries to secure the control of forests and their management on scientific principles, and expressed the hope that the labors of the committee recently appointed by the Board of Agriculture, and at present sitting, would result in removing from Great Britain the reproach of being the most backward country in respect to forestry. Turning to means of cheap transport, he suggested that the time was coming when the main roads should be placed under one management throughout the country, and become a national charge instead of a charge on the local rates. Good roads, with organized steam traction, would be more useful to farming than would light railways. Considering next the generation of power, Mr. Hawkshaw remarked that water power possessed important advantages in its cheapness and also in its certainty, which was assured as regards the minimum supply; moreover, its cost was practically independent of the fluctuating cost of fuel and labor. Up to the present it was the electro-chemical industries which had taken most advantage of cheap water power, and some of its applications in this direction were briefly alluded to. The difficulties connected with the utilization of water power arose out of the necessity of storage for regulating the flow, a matter of little difficulty where lakes could be used for storage in uncultivated country, but entailing works of almost prohibitive cost where any alteration of the accustomed water-level led to interference with vested interests. The address concluded with some remarks on the relation of the biological sciences to the work of the engineer.

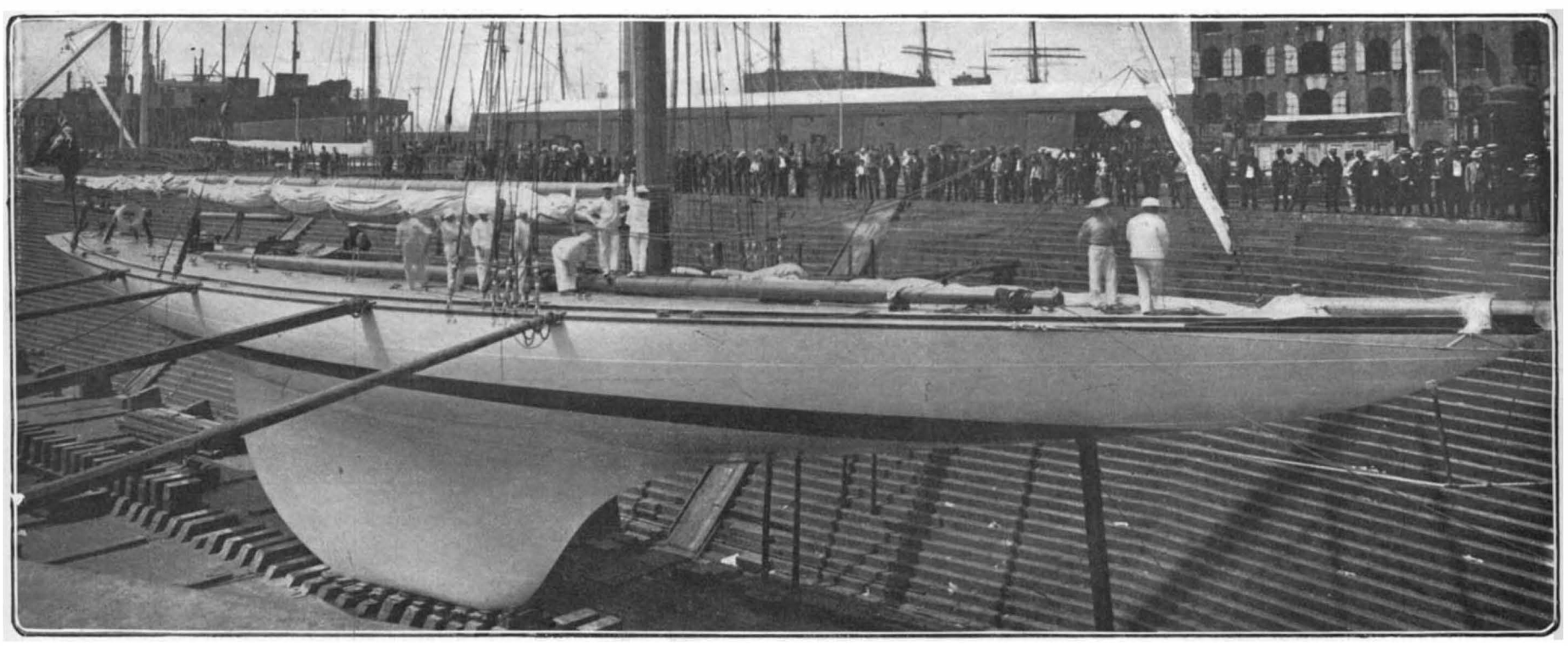
DEVELOPMENT OF THE 90-FOOT RACING YACHT.

When Commodore John C. Stevens and his four associates, all of the New York Yacht Club, gave an order to George Steers for the construction of a schooner for the purpose of crossing the Atlantic Ocean and competing in friendly rivalry with British yachtsmen, they little imagined what an important influence their trim little craft was ultimately and indirectly to exert upon the international relations of the two greatest nations of the world; for, insignificant and disproportionate as the cause may seem to be, there is no denying that the international contests for the "America" cup have grown to such a point of importance that they are a very real factor in the growing friendship between the two nations. Could the shades of the gallant commodore and his friends have hovered off Sandy Hook lightship somewhere about noon on August 20, and witnessed the vast flotilla of steamships, big and little, come streaming out past the Hook, they must have felt that verily great things from little causes grow; for, after all is said and done, that first appearance half a century ago of an American schooner among the British yachts was a nautical event of merely local and passing interest. Evidently it was so regarded at the time, for there was a lapse of nearly twenty years before any effort was made to recover the cup won in so gallant style by the "America." If the real cause for the world-wide interest that has sprung up around these contests is to be sought, it will be found in the splendid enthusiasm with which our American yachtsmen responded to the first challenge that was received and the strongly national flavor which the contest at once assumed, as evidenced by the crowds which flocked down to the lower bay to witness the races of 1870 between the solitary British schooner "Cambria" and the great fleet of American yachts that was gathered to protect the cup. Already, by this very enthusiasm, the yachting trophy was enshrined in the popular mind as the type of American supremacy in the building and sailing of yachts. It is true that the early races were marked by more or less wrangling and much overearnest disputation which culminated in the disgraceful fiasco of the "Valkyrie"-"Defender" races; but from that time on there has been evidenced a more considerate attitude both upon the part of the challengers and defenders, which is unquestionably based upon the realization of the fact that after all an "America" cup contest is a sporting event, and that, as such, it should be carried out in a spirit of perfect friendliness and good-will. This better feeling and more broad-minded spirit has developed to such a degree that to-day quite a considerable section of the American public, not a few of whom are yachting experts, is desirous that the splendid pluck and determination of the British sportsmen should at length be rewarded by the capture of the much-coveted emblem.

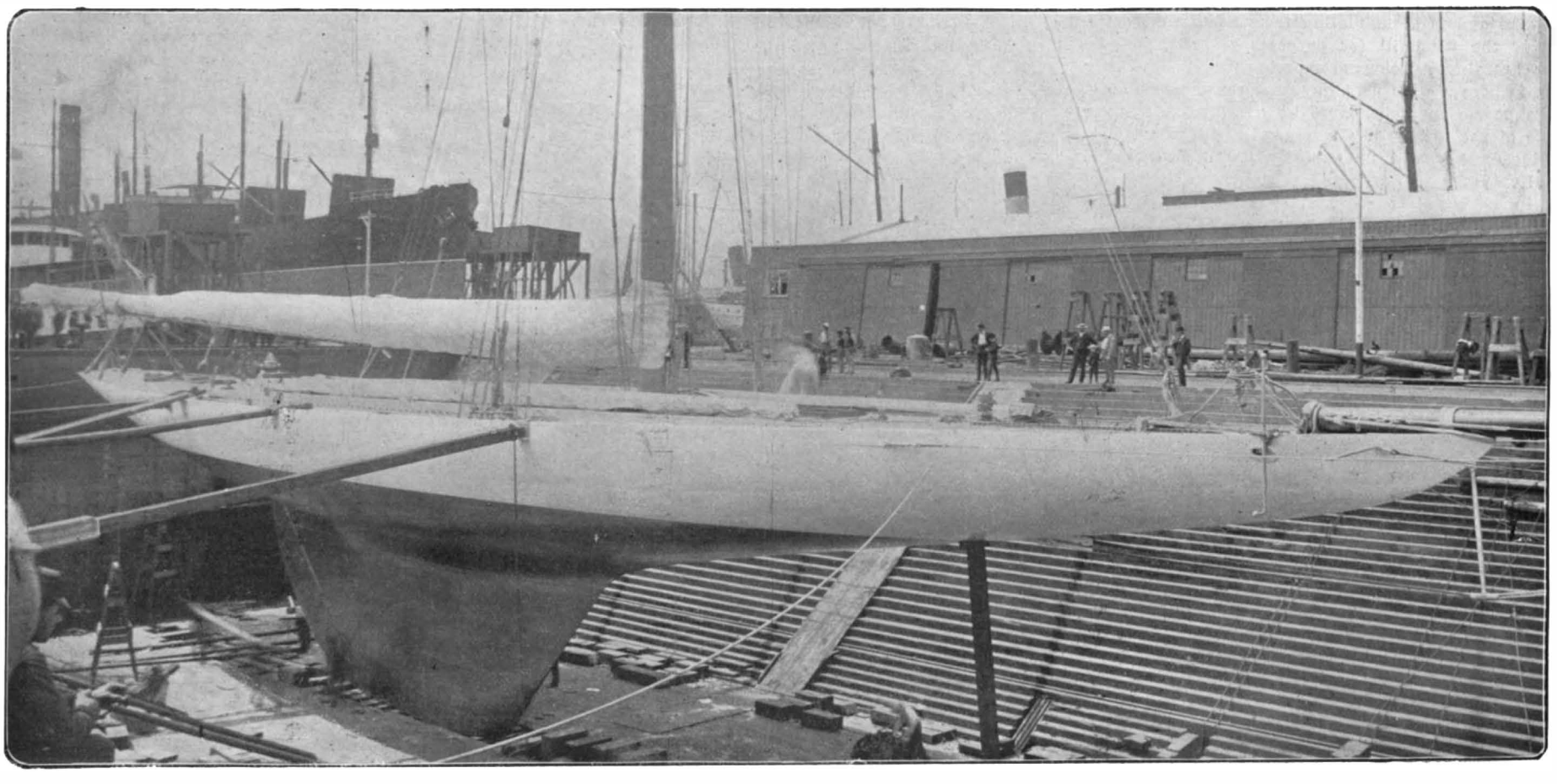


Shamrock III., Bow On.

It is not our intention in the present article, however, to enter into the ethics of the sport, but rather to trace in a broad way the remarkable development which has taken place during the half century or more of these contests. We have so fully frequently illustrated and described the various contests, that it will be sufficient in this article to present the accompanying series of drawings showing the challenging and defending yachts that have been built and have fought it out on the Sandy Hook courses since the year 1885, when the cutter "Genesta" and the centerboard "Puritan" had their ever-memorable struggle. The fifty-two years from 1851 to 1903 may be divided broadly into three periods. The first of these, extending from 1851 to 1876, might aptly be termed the schooner period. The first of these races held in 1870 was represented on the part of the challengers by the "Cambria," a deep-keel schooner built by the Ratseys, who have since figured so largely as makers of the famous English sails.



Shamrock III., From Off Starboard Bow.

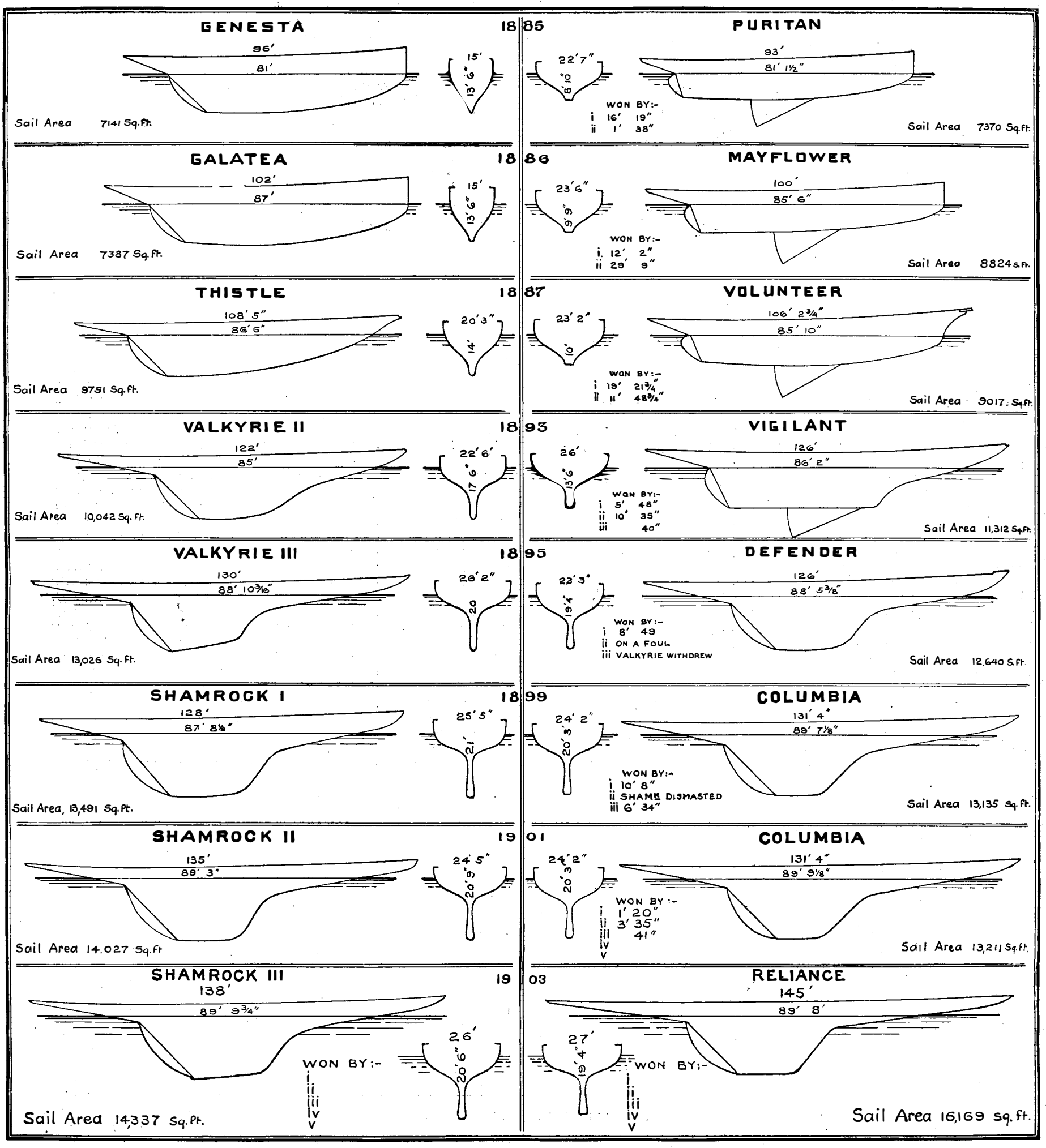


Photographs taken by the Staff Photographer of the Scientific American.

Reliance, From Off Starboard Bow.

THE YACHTS IN DRYDOCK BEFORE THE FIRST RACE.

She was a vessel of 108 feet water-line length, and she was handsomely beaten by several of the yachts which sailed against her. The second challenge was sent by Mr. Asbury, who was also the owner of the "Cambria." When his schooner, the "Livonia," reached this side of the water, she was found to be an improved "Cambria," with a water-line length of 115 feet and a proportionately larger sail spread. She made a better fight for the cup than her predecessor, winning a race against "Columbia" by 25 minutes and 28 seconds and thereby earning the distinction of being 10 minutes and 59 seconds, and in the second race by 27 minutes and 14 seconds. The Canadian club had another try for the cup, this time with the sloop "Atalanta." She had none of the qualities for such an arduous task, being beaten by the "Mischief" in the first race by 28 minutes and 20¼ seconds, and in the second race by 38 minutes and 54 seconds. Strictly speaking, the "Atalanta" series of races should be included in the first or schooner period, for the reason that the vessels engaged in this event, as in all previous contests for the cup, were designed by the rule-



DEVELOPMENT OF THE INTERNATIONAL RACING YACHT FROM 1885 TO 1903.

the only challenging yacht that has won a race for the cup. She was defeated, however, in the series, succumbing in her second race to the "Columbia," in the third race to the "Dauntless," and in the fourth and last race to that famous schooner "Sappho." The next challenge was sent by the Royal Canadian Yacht Club, and the Canadian club secured the obviously fair concession that only a single cup defender should be sent against their yacht, and that she should be selected several days before the first race took place. The "Countess of Dufferin," as she was called, was beaten by the schooner "Madeline" in the first race by

of-thumb methods of the early yacht designers, and it was not until the second period, extending from the "Genesta"-"Puritan" races in 1885, to the "Valkyrie"-"Vigilant" contest of 1893, that the modern scientific method of design was ushered in. This second period was marked by the grand struggle between the English deep-keel cutter and the American centerboard sloop; for there is no denying that just as the deep-keel was the slogan of the Briton, the centerboard was the cherished ideal of his American competitor. Speaking of the British side of the contests, we see in the growth from "Genesta" to "Valkyrie II." a develitán" of 22 feet 7 inches, and a draft of 8 feet 10 inches, in "Valkyrie II." the beam had increased to about the same as that of "Puritan," while the depth of the keel in the American sloop "Vigilant" had grown to 13 feet 6 inches, or exactly that of the "Genesta" of eight years before. The year 1893 was an epoch-making year in the history of the development of the cup yacht, and the most significant fact in the "Vigilant" series was the very conclusive beating given by the English cutter to the American centerboard sloop in a memorable race of 15 miles to windward when the English cutter turned the mark nearly 2 minutes in the lead.

The doom of the centerboard was further sounded by the visit subsequently paid by "Vigilant" to Great Britain when she lost eleven out of eighteen races to the "Britannia," a sister cutter to "Valkyrie."

The third phase of yacht construction may be said to date from the construction of the American yacht "Defender" in 1895. Just as the "Genesta"-"Puritan" year saw the introduction of more thoroughly scientific methods of design, so does the "Valkyrie III."-"Defender" series witness the full recognition of the fact that scientific construction is only less important than scientific design. Of course, it would be manifestly unfair, both to the British designers and to Herreshoff himself, to infer that no attention had been paid previously to what might be called the engineering features of the problem, for "Genesta" in 1885 was of composite construction, with wood planking on steel frames, and "Galatea" in 1886 was built entirely of steel, at a time when we were still clinging to cumbersome wooden frames in "Puritan" and "Mayflower"; moreover, Herreshoff had already introduced, in 1893, the use of bronze in the underbody of "Vigilant." But it was in "Defender" that the engineer and metal worker were first given a free hand, while hollow steel spars first made their appearance on both challenger and defender. It is probable that "Defender" was, and will always remain, the lightest yacht for her size ever constructed; she has also the unenviable distinction of being the only boat built either for challenge or defense that was useless as soon as her racing days were over—for, contrary to popular belief, the three 'Shamrocks" and their competitors are as sound to-day as when they were launched. "Valkyrie III." was of composite construction; but in her we see the last of the wood-sheathed cutters.

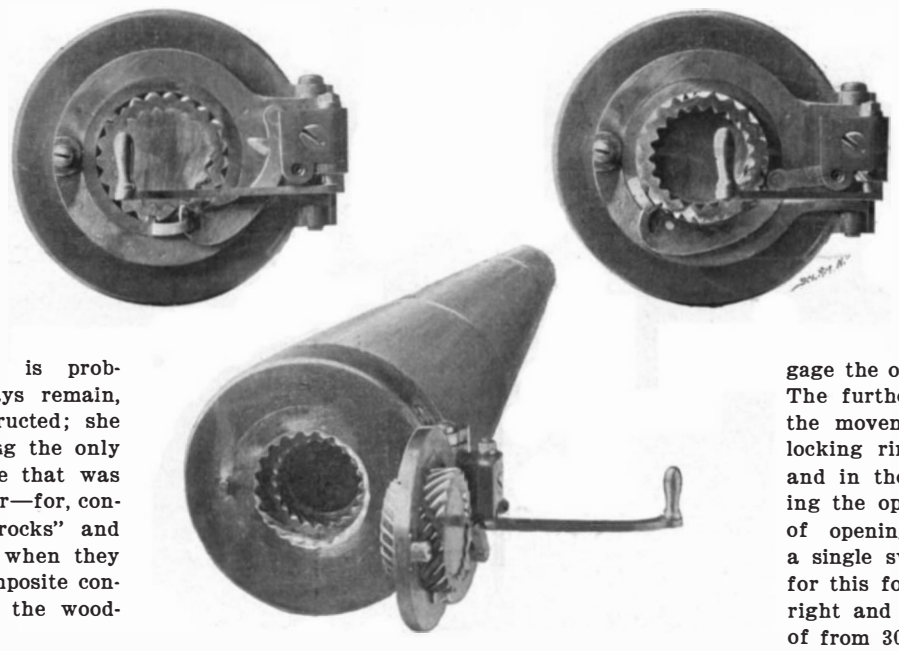
With the advent of Sir Thomas Lipton to the great international contest, there was assured for the challenging yachts the necessary capital to meet the enormously-increased cost of construction due to the use of expensive alloys and high-grade steel; and although in this respect it has been one man's purse against a syndicate, no stint has been put upon either the designer or the builder. The first "Shamrock" was a bronze boat with aluminium topsides and deck, and in "Columbia" she met a boat with bronze underbody, steel topsides and wooden deck. The second "Shamrock" was plated with bronze from keel to rail; but in "Shamrock III." we see a return to steel plating for the hull, the necessary smoothness of surface being secured by the use of a special enamel paint, each coat of which is carefully rubbed down before the next is applied. The result is a remarkably smooth surface which it is claimed is not surpassed by the polished bronze. "Reliance" is built on the belt-frame and longitudinal system which Herreshoff introduced in "Constitution." It is possibly a trifle lighter than the customary bulb angle method of framing; but it posseses the drawback that the wide frame-spacing renders it difficult to build the boat with perfectly fair lines, the plating having a tendency to straighten out between frames, rendering the longitudinal lines a series of chords instead of true continuous curves. In this last period of cup designing there has been a wonderful development in the sizes and power of the boats, until the climax has been reached in "Reliance." As compared with "Defender," the beam has gone up from 23¼ feet to 27 feet, and the over-all length from 126 to 145 feet, while the sail spread of 12,640 feet on "Defender," thought to be prodigious in 1895, would be insignificant against the towering fabric on "Reliance," with its total area of 16,199 square feet.

As we go to press, only one meeting of "Reliance" and "Shamrock" has taken place. The wind, light at the start, died away at times to a calm. Although the race was called off, "Reliance" showed indications of being the better drifter. As long as the wind held true, there was but little appreciable difference between the boats, although "Reliance" gave indications that in a true breeze she could draw out to weather of the English yacht. The conditions were those in which "Shamrock" has done her best work, and if she cannot drop "Reliance" in a light breeze and rolling sea, she is not likely to do so in stronger breezes.

The largest complete mounted mammal in existence can be seen in the American Museum of Natural History. The specimen is the clumsy little skeleton of the pantolambda, whose age is placed, with doubtful accuracy, at three million years. The fossil was found in New Mexico and presents an impressive example of the possibilities of evolution.

IMPROVED BREECH MECHANISM FOR HEAVY GUNS.

The vast improvement that has been made of late years in the rapidity of fire and general handiness of heavy guns is due largely to the great amount of attention which has been given to the breech mechanism. So important an element is this in the construction and manipulation of heavy ordnance, that it has had more to do with decreasing the weight and increasing the rapidity of fire than perhaps any other single feature. If we except the guns made at the Krupp works, the breech mechanism of all modern ordnance is of the threaded type, that is to say, after the charge has been introduced, the breech block or breech plug depends for its ability to resist the rearward force of the explosion of the powder upon the total strength of the threads by which the block is screwed home to its position in the breech box. As usually constructed, equi-distant parallel channels are cut through the threads both of the block and the box, so that the breech block can be thrust right home into position and locked by giving a third or quarter turn to the block as the case may be. This cutting away of so large a portion of the thread, thereby reducing the shearing section, necessitates an increase in the length of the block and, therefore, an increase in the length of the gun at the point where it carries its greatest diameter. To provide a breech block of less depth, but presenting an equal section of thread, thereby saving in the length and weight of the gun, has been the constant aim of gun-makers for several years past, and in the accompanying illustrations is shown one of the latest and most ingenious attempts to solve this problem. In the new breech mechanism, which was designed by John B. Moore, of Washington, D. C., the breech box is stepped so as to present two different diameters, and the outer or larger section is threaded with a left-hand thread, and the inner or smaller section adjoining the powder chamber is threaded with a right-hand thread, the threads in both cases being uninterrupted. The breech block, which has a diameter corresponding to that of the interior section of the breech box, is cut with a left and right-hand thread, corresponding to that of the breech box, the length and pitch of the threads corresponding to those of the two sections of the breech box, although the diameter of the breech block is the same throughout and matches that of the inner section of the breech box. Over the outer left-hand-threaded portion of the block is carried an annular locking ring which is cut both on its interior and exterior surface with a left-hand thread. This locking ring is threaded on over the outer part of the breech block, and it is itself carried by a swinging carrier, which is hinged in the customary way to the right-hand edge of the base of the gun. The carrier for this breech block is swung into an open or closed position by means of a handle lever, and by the co-operation of a pair of bevel pinions suitable motion is transmitted, during the swinging of the handle lever, to a rocker which is pivotally connected with the operation ring in such a manner that this operating ring is moved in one direction or the other according to the opening or shutting swing of the handle lever.



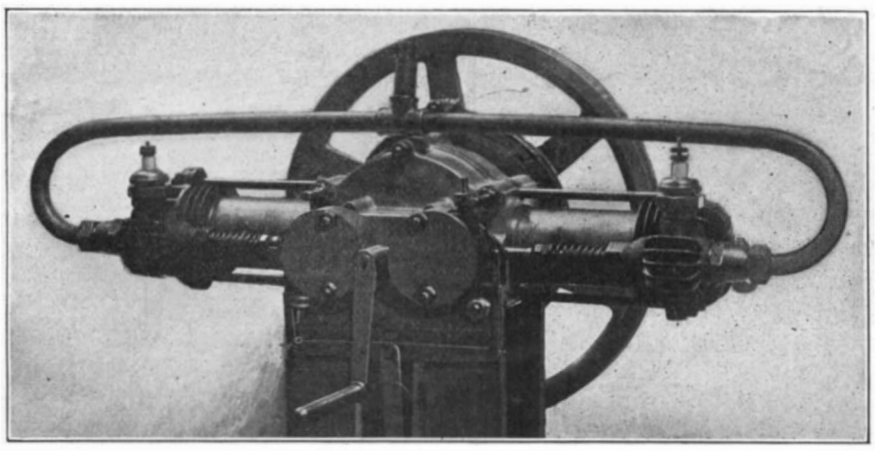
IMPROVED BREECH MECHANISM SHOWN IN THE LOCKED, UNLOCKED, AND FULLY OPEN POSITIONS.

Our three engravings show the breech first, in an entirely closed and locked position; secondly, with the breech block unscrewed, but still in position against the breech of the gun; and thirdly, with the breech block swung wide, clear of the gun, ready for the insertion of the charge. Let us suppose now that the charge has been inserted and it is desired to close the breach. By pulling the handle lever round to a quarter turn the block will be brought up with the ends of its threads in position against the ends of the threads of the breech box, ready for screwing home to position. The further movement of the handle lever toward the gun then operates to turn the breech block into the threaded portion of the gun breech. This is accomplished by turning the locking ring on the threads of the breech block, when the threads of the block will engage the outer ends of the threads of the gun breech. The further movement of the handle lever reverses the movement of the operating ring and turns the locking ring in on the threads of the breech block and in the threads of the gun breech, thus completing the operation of closing. Each of the operations of opening and closing is thus accomplished by a single swing of the lever. The advantages claimed for this form of construction are that by using these right and left-hand multiple threads there is a gain of from 30 to 50 per cent of strength over any block of the same weight and general dimensions that is at present in use. The considerable shortening-up of the breech of the gun, due to the shortness of the breech block, not only greatly lightens the weapon, but it allows for more advantageous disposition of loading and hoisting machines, particularly in large gun mounts. There is a further advantage in the fact that by dividing the strain occasioned by firing the gun equally between a right and a left-hand thread, there is obtained the advantage of equilibrium of forces; the operating mechanism is relieved of strain or shock, and there is no tendency, as in a block carrying the ordinary type of thread, for the block to unscrew itself. Another advantage is that when the swinging carrier strikes the gun, the momentum of the breech block causes it to enter its threads in the block for a considerable distance, thereby rendering a rebound of the carrier before the block enters impossible, and because of the great pitch of the threads the momentum of the block is almost sufficient to screw it home to its closed position.

LIGHT MOTOR FOR A ST. LOUIS CONTEST AIRSHIP.

The coming race of airships at the St. Louis Fair is doing a great deal to interest inventors in the problems of aerial navigation, and as a result we may expect to find substantial advances made in this most fascinating effort of man to master the element which has so long baffled him.

One of the goals toward which all designers of airships are striving is the construction of a propelling motor which shall have a minimum weight per horse power. A prominent contestant in the St. Louis race has just succeeded in obtaining an exceedingly light gasoline motor for his airship. Our illustration shows the motor with the carbureter removed, mounted on the testing block. The motor was built by the Walters Power Company, of 62-66 Van Winkle Avenue, Jersey City, N. J. The contract stipulated that the motor alone should weigh not more than 26 pounds and should yield at least 2 horse power. The completed motor comes well within these requirements, having a weight of about 24¼ pounds and an efficiency of 2¼ horse power. Even with the addition of the carbureter, the weight is but 25½ pounds, and naturally the builders are much elated with their success. In the construction of the motor aluminium is, of course, used wherever possible, and the other parts are made as small and compact as practicable. The general design, however, closely follows standard lines. The motor is of the four-cycle type and the cylinders have a 2⅛-inch bore by a 2 7-16-inch stroke. One feature which is particularly noticeable is the absence of radiating ribs on the main body of the cylinders. Mr. Walters, who designed the motor, has found that the heat of the cylinders could be dissipated with suffi-

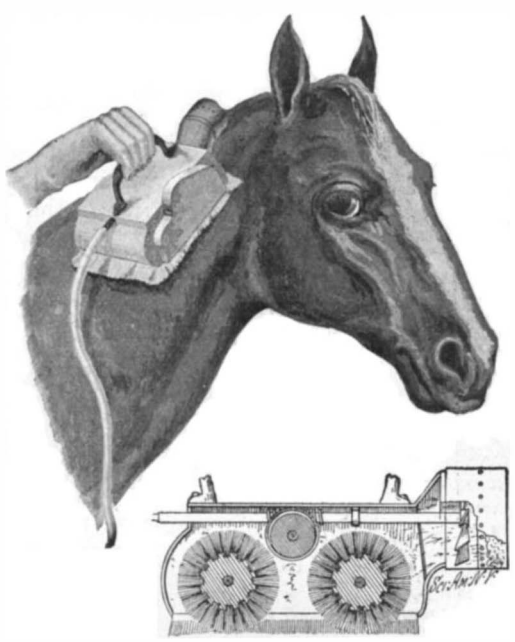


GASOLINE MOTOR WEIGHING 24¼ POUNDS, YIELDING 2¼ HORSE POWER.

cient rapidity from the smooth surface of the cylinder. However, in order to insure sufficient strength, he retained the ribbed formation on the cylinder heads and the valve casings, for at these points the pressure is, of course, the greatest. A special form of carbureter is used, which comprises a double valve and insures separate control of the gasoline and air supply. Control of the sparking may be had by operating a lever depending from the lower part of the motor. This changes the position of the sparking contacts with relation to their operating cams, and thus advances or retards the time of the spark in the cylinder. A friction clutch and pulley shown at the rear of the motor were added after the motor was built, and these increase the total weight to 33½ pounds. On completion of the motor it was subjected to thorough tests and proved highly satisfactory in every particular.

MACHINE FOR GROOMING AND SHAMPOOING HORSES.

Two Western inventors have just received a patent for an ingenious machine adapted to be used for grooming and shampooing horses. The machine is designed particularly with a view to doing the work rapidly and in a cleanly manner, means being provided for confining the dust and sweepings to a specially-constructed dust chamber. The apparatus may be operated by a flexible shaft connection with any suitable motor. The flexible shaft is attached to the main shaft which passes lengthwise through the center of the machine. A worm gear formed on this shaft meshes with a gear on a shorter shaft lying at right angles therewith. At one end of the shorter shaft a friction device of cup-shape is formed, within which the main pulley projects. The diameter of this pulley is smaller than the diameter of the cup so that it may be shifted from one position to another without interfering with its rotation so long as its periphery has frictional contact at some point with the cup. Lying on either side of the shorter shaft are two brushes which are rotated by means of friction disks engaging a large disk connected with the main pulley. Ordinarily both brushes will rotate in the same direction, but by reason of the freedom of movement allowed the main pulley the friction disk directly connected therewith may be shifted, so as to bring it into contact with an "idler," through the medium of which the direction of one of the brushes may be reversed. The entire mechanism is covered by a casing open at the bottom to permit operative contact of the brushes with the animal to be groomed. In order to prevent spread of dust raised by the brushes, the dust is confined to the casing by screens of fringe work which hang from its lower edges. It will be observed that the right-hand end of the main shaft is provided with a suction fan lying in the dust chamber which projects from the main casing. This chamber is closed by a perforated cap provided with a sponge or other dust-absorber, so that when the fan operates to draw out the dust raised by the brushes, the dust will lodge in the absorber while the air passes out through the perforations. In operating this machine the operator needs simply to guide it over the animal's body and the work will be



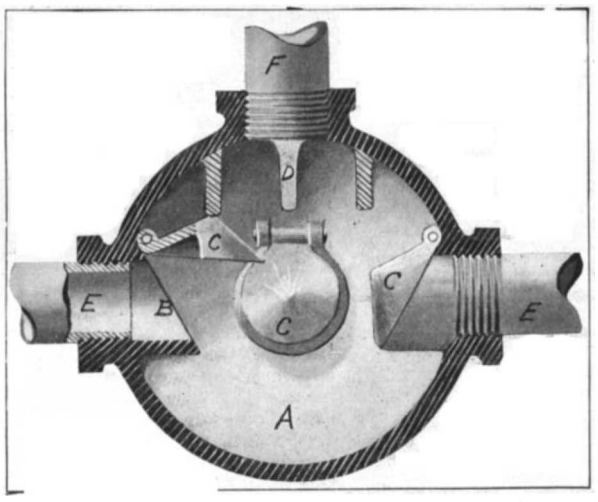
A HORSE-GROOMING MACHINE.

easily and expeditiously done. Messrs. Anders and Pehr Bolund, of 16 Hancock Street, East San José, Cal., are the inventors of this grooming and shampooing machine.

The Pennsylvania Railroad tunnel under the Hudson River was begun on June 25. The tunnel work is divided into two sections, known as the northern and the eastern sections. The first drill holes for first shaft were started at noon at the foot of 32d Street and Eleventh Avenue, New York.

IMPROVED VALVE MECHANISM.

The accompanying engraving illustrates an improved valve mechanism which is especially adapted for connecting a battery of boilers with a main steam pipe. The valve has been designed with a view to effecting a great saving of fuel and to act as a safeguard against explosion of the boiler. A patent for the improved construction has recently been obtained by Mr. Thomas Simpson, of New Iberia, La. The valve mechanism comprises a casing *A*, and opening into this are a number of passageways *B*, preferably four in number. These are threaded to receive the pipes *E*. The end walls of the passageways are beveled or inclined and over them the conical valve caps *C* are situated, being hinged to the casing. The passageways are arranged diametrically opposite each other,



VALVE MECHANISM FOR A BATTERY OF BOILERS.

so that when one of the valves is open and steam is passing therethrough, the valve directly opposite will be held in its closed position unless the steam pressure in this closed pipe is sufficient to overcome the pressure from the opposite steam duct. The main steam pipe *F*, which is formed at the upper portion of the valve casing, is adapted to permit the escape of the steam from the casing. A number of lugs *D* are formed on the interior of the casing. These serve as stops for the valve caps when they are suddenly forced upward by the pressure in the pipes. In large sugar refineries explosion of the boilers frequently occurs, due to the fact that when a connection is made between boilers the pressure of one battery exceeds the pressure of the other. This may be obviated by the use of Mr. Simpson's improvement. It will be observed that an excess of steam in the boiler is immediately relieved and is permitted to escape through the valve mechanism, without the necessity of an attendant being present to regulate the same, and such an advantage is obviously very important.

Across the Continent by Automobile.

The crossing of the continent of North America in sixty-one days is the latest achievement of the automobile.

The test was undertaken by the Packard Motor Car Company in order to demonstrate the trustworthiness and ability of their 12-horse power standard touring car. Mr. T. E. Fitch, their most experienced operator, was chosen to run the car, and he was accompanied by M. C. Krarup, an newspaper man. The start was made from San Francisco on June 20, and the mud-covered car, christened "Pacific," reached New York at 8.30 P. M., August 21—just two months and one day later. The route followed was across the Rocky Mountains to Carson City, Reno, Battle Mountain, and Wells, Nev.; Tacoma, and Salt Lake City, Utah, the latter place being reached on the 4th of July; Glenwood Springs, Buena Vista, Colorado Springs, and Denver, Col., Denver being arrived at July 20; then through Nebraska to Omaha, which was reached on July 31 and stopped at till August 2; Des Moines, Iowa, was reached on August 4, and Chicago, Ill., on August 10; while ten days were consumed in covering the last 1,000 miles from Chicago to New York. Aside from tires, but one serious breakdown occurred on the machine, which consisted in the breaking of a front spring. A new spring was obtained *en route*. One of the original tires on the machine at the start is said to have survived to the finish. Beside this tire, seven new outer casings were used in replacing the other three. The weight of the machine complete was about 2,700 pounds.

Regarding the character of the roads traversed, Mr. Fitch is reported to have said that neither Utah desert nor Colorado mountains were half as bad as the common mud met with in all sorts of places. In Iowa the mud was so bad that with chains on the wheels it was difficult to get sufficient traction to run through it. The shortest day's run in the entire journey was twenty-four miles in this State. The roughest going was in Colorado, between Grand Junction and Colorado Springs.

The Packard single-cylinder car is the second to accomplish the feat of crossing the continent. The first machine to cover the distance was a Winton 20-horse-power touring car driven by Dr. Nelson Jackson, of Burlington, Vt., who arrived about a month ago, accompanied by a chauffeur. Dr. Jackson took a longer and more northerly route, and had a great deal of tire trouble; but, in spite of many, difficulties, he succeeded in making the trip in only four days' longer time than the Packard party. A third expedition, with an Oldsmobile light runabout, is now being undertaken by two other men. A motor-cycle driven by George A. Wyman was the first motor-driven machine to ever complete this journey. This arrived in New York several weeks before Dr. Nelson, after having been ridden by Mr. Wyman many miles over railroad ties when no roads were to be had.

Food Frauds Abroad.

In Paris snails are popular, and the adulterators mix them with lungs of cattle and horses. Even entirely artificial snails are manufactured. The shells, recoated with fat and slime, are filled with lung and then sold as "Burgundy" snails. Lovers of fresh rooster combs are imposed upon by a substitute cut out of hogs' intestines.

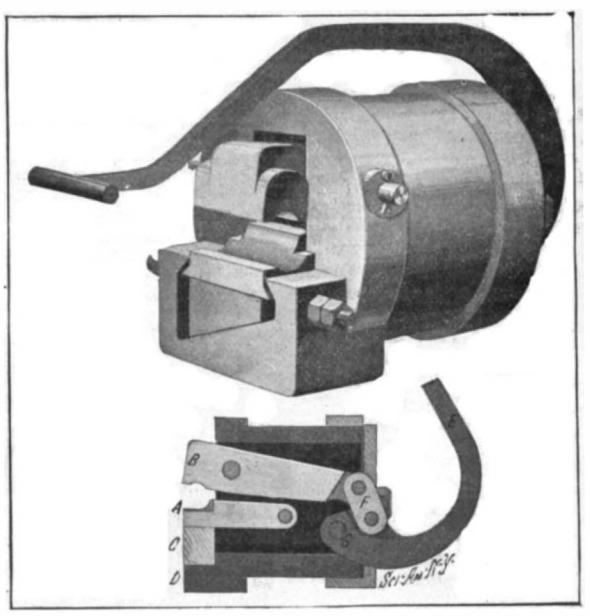
Chopped artificial truffles are made of black rubber, silk, or softened leather, and even whole truffles are made out of roasted potatoes, which are flavored by adding ether. They are said to sell well.

Fish spoiled in spite of ice and borax is treated with salts of zinc, aluminium, and other metals. Rubbing the fish with vaseline to give it a fresh look and coloring the gills with fresh blood or eosin—a coal tar color—is resorted to. The latter is also used to intensify the red color of inferior crabs.

Imparting a greenish color to oysters is another adulteration. An oyster requires about one month in the beds to acquire the greenish color. As this is too long a time, the dealers help them along with an artificial color. The chemists in the Paris municipal laboratories have shown that tomato jelly is adulterated with turnips and powdered pepper contains a large admixture of powdered hardtack.

CABLE GRIP OR CLUTCH DEVICE.

Messrs. Ludwig Schuler and Joseph Ericson, of Telluride, Colo., have just obtained a patent on an improved cable gripping device, for use in connection with traveling ropes or cables of traction or other similar railways. The device is very effective and reliable in operation, besides being capable of easy control, and it contains no parts which will get out of order or be easily broken. It comprises a cylindrical block, in which is formed an opening of rectangular cross section which is adapted to receive the two jaws *A* and *B*, as shown in our detail view. The lower jaw *A* is pivoted to the block at its inner end, and at its outer end rests on a wedge *C*. This wedge is provided with screws, one at each end, which project through slots in the corresponding sides of an extension *D* on the block, as shown best in the perspective view of the device. By means of nuts on these screws the wedge *C* may be moved toward the right or the left, thus



AN IMPROVED CABLE-GRIPPING DEVICE.

raising or lowering the jaw *A*. The purpose of this adjustment is to adapt the device for gripping various sizes of ropes or cables. The upper jaw *B* is hinged to the block near its gripping end, and at the opposite end is connected to an operating lever *E* by a toggle link *F*. The operating lever is pivoted to the block at *G*, so that when the lever is swung about on its axis, the lower end of the toggle link will be moved inward, raising the inner end of jaw *B* and causing its gripping end to come down with a powerful grip onto the cable resting on the lower jaw *A*.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

MERCURY SAFETY ATTACHMENT FOR ELECTRIC CIRCUITS.—E. MIES, BÜDESHEIM, Germany. The invention relates to that class of safety appliances which permit a sure and complete breaking of the current in the case of short-circuit or overloading and which at once after the interruption of the current can be brought into perfect working order, and thus fully replace an automatic device. This appliance is based on the well-known use of mercury, and is adapted for use with high-tension currents, where unprotected circuits may not be touched and contacts must be avoided, and is applicable to all systems of safety appliances.

Engineering Improvements.

ROTARY EXPLOSIVE-MOTOR.—A PRIMAT, 38 Rue d'Hauteville, Paris, France. In this case the invention refers to a rotary motor of extremely small weight, the motive power of which may be either steam, petrol, alcohol, or gas. The motor is characterized by a kind of ring or rim, divided by radiating partitions in such a manner as to constitute by their combination with the pistons a certain number of cylinders—four, for example. When operated with petrol, alcohol, or gas, it may be constructed as a motor working with a cylinder of four phases and provided with four pistons or for two phases with two pistons.

Household Utilities.

BABY-WALKER.—J. L. PHILLIPS, Washington, N. C. This invention relates to certain improvements in the construction and manner of suspending baby-walkers—that is to say, devices used for encouraging children to walk. The child is free to move around in various directions, but it is at all times supported, and is allowed to press only a small portion of its weight upon its legs.

Machines and Mechanical Devices.

DEVICE FOR OPERATING ELEVATOR-GATES.—H. J. GUTH, Evansville, Ind. The inventor seeks in the present improvement to provide means for positively opening or raising the elevator-gate on the ascending and descending movements of an elevator cage or car, said devices acting automatically to impart the required movement to the gate and some of the devices being in like manner moved out of operative position temporarily, so as to avoid breakage, and thereby insure the operation of the mechanism.

CHANGEABLE SIGN.—M. B. DISKEN, New York, N. Y. Mr. Disken's invention comprises a framing holding together a number of blocks of various shapes, the blocks being arranged in a master grouping and forming a solid mass when assembled. These blocks are independently movable into protruded or retracted positions and are of such form that by pushing some of the blocks in or out, as the case may be, any letter or figure will be described. The blocks are connected with certain mechanism by which the proper ones may be selected and pushed forward.

Miscellaneous.

FLEXIBLE BAG.—JOSEPHINE MÜLLER, New York, N. Y. The purpose of this invention is to provide a construction of bag wherein a fabric is employed woven in a tubular shape and closed in weaving at one end, which fabric is folded upon itself in such manner that its open end is carried inward in direction of the closed end and its open end is concealed. Thus a bag is produced made in one continuous tubular length comprising an outer wall and an inner wall independent of the outer one, the two walls being without a seam at the mouth and sides of the bag and the outer wall without a seam at its bottom.

BOTTLE.—N. D. ASDELL, Lakeview, Ore. According to this invention the bottle is closed and sealed by a cork or other stopper inserted in the lower portion of the neck, and a laterally-projecting lever is connected with such a stopper, so that it may be used to dislodge the latter, and thus unseal the bottle. The fulcrum of the lever is movable, it being preferably a soft-metal ball, and when dislodged it serves to hold the lever in an abnormal position, from which it cannot be shifted.

REFRACTOMETER. — W. L. BURNAM, Kansas City, Mo. The inventor's object is to provide an instrument adapted to measure eye troubles embodying in its construction three lenses, through all of which the eye examined looks at all stages of the test and without being required to look at an opaque object. Two of these lenses are mounted adjacent to each other and are combined with means for adjusting them rotarily. The third lens or objective is adjustable toward and from the pair of lenses.

TOILET-PACKAGE CABINET. — F. H. DAWES, Johnstown, N. Y. The purpose in this case is to provide a cabinet that will hold, for example, one thousand sheets and provide means for conveying them forward one after the other to an engagement with distributing-rollers and to so locate the rollers that after the first sheet has been manually exposed through the medium of the rollers the action of withdrawing the exposed sheet will automatically cause a second to be exposed at the outlet-opening, this occurring each time a sheet is removed.

TEMPORARY BINDER.—A. L. HOLTON, Norfolk, Va. This inventor's improvement is in the nature of temporary binders for use on note-books especially designed for use by stenographers; and the invention provides a combined temporary binder and a support for a book or tablet when used in taking notes and held in the hand by the writer instead of on a desk or other like support.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

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Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 4504.—To manufacture and market a patented article on royalty.

AUTOS.—Duryea Power Co., Reading, Pa.

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Morgan Emery Wheels. Box 517, Stroudsburg, Pa.

Inquiry No. 4506.—For manufacturers of cement work tools, etc.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 4507.—For manufacturers of oil filters.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 4408.—For manufacturers of small table fans and large ceiling fans worked by clock-work mechanism and spring power.

Mechanics' Tools and materials. Net price catalogue. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 4509.—For manufacturers of racing shells.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 4510.—For parties to whom to apply for second-hand upright engines, portable boilers, portable railway track for construction, and construction dump cars.

For metal articles, any kind, made any shape, write us. Metal Stamping Company, Niagara Falls, N. Y.

Inquiry No. 4511.—Wanted address of instrument makers.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 4512.—For manufacturers of woven hose, same as garden hose without rubber on it.

Automobiles built to drawings and special work done promptly. The Garvin Machine Co., 149 Varick, cor. Spring Streets, New York.

Inquiry No. 4513.—For manufacturers of machinery for making gents' collars, also for firms making celluloid goods.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 4514.—For manufacturers of pressed brick machines.

We manufacture anything in metal. Patented articles, metal stamping, dies, screw mach. work, etc., Metal Novelty Works, 43 Canal Street, Chicago.

Inquiry No. 4515.—Wanted a "Humatone," a musical instrument which produces a whistling noise.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 4516.—For manufacturers of porcelain or agate buttons.

Contract manufacturers of hardware specialties, machinery, stampings, dies, tools, etc. Excellent marketing connections. Edmonds-Metzel Mfg. Co., Chicago.

Inquiry No. 4517.—For parties to manufacture a file eraser.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 4518.—For makers of glass paper weights 2½ x 4 inches and ⅞ inch thick.

WANTED.—A gas producer engineer or draftsman familiar with construction and operation of gas producer. State experience. Weber Gas and Gasoline Engine Co., Kansas City, Mo.

Inquiry No. 4519.—For manufacturers of small silver-toned bells.

American inventions negotiated in Europe. Felix Hamburger, Equitable Building, Berlin, Germany.

Inquiry No. 4520.—For manufacturers of porcelain plates for lining refrigerators.

An established firm of importers in London, England, invite correspondence from firms of good standing having specialties suitable for the British or colonial market. Cash against bill of lading, if desired. Write "Importers," c. o. "SCIENTIFIC AMERICAN," New York.

Inquiry No. 4521.—For canal-making machinery for drainage canal 6 feet deep.

Inquiry No. 4522.—For manufacturers of alarm door knobs.

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Inquiry No. 4525.—For manufacturers of cutlery, furniture, pianos, cycles, lamps, and iron bedsteads.

Inquiry No. 4526.—Wanted addresses of manufacturers of advertising novelties.

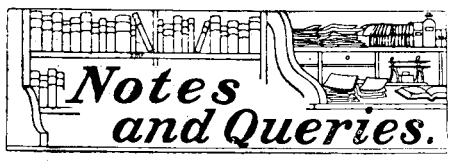
Inquiry No. 4527.—For manufacturers of gasoline engine 2½ or 3 h. p.

Inquiry No. 4528.—For manufacturers of steel and brass springs, racks, ratchets, pinions, machine screws and worm gearing, also nuts.

Inquiry No. 4529.—For manufacturers of steel tubing, type, castings, rods, and spindles.

Inquiry No. 4530.—For manufacturers of perforated metals to order.

Inquiry No. 4531.—For manufacturers of typewriter platens, die plates and taps, malleable castings, gutta-percha and celluloid and bone knobs for typewriters.



HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Minerals sent for examination should be distinctly marked or labeled.

(9161) G. R. B. says: Will you kindly oblige me by answering the following question in your Notes and Queries of the SCIENTIFIC AMERICAN? What is the specific heat at about 250 deg. F. of syrup of such a consistency, that is, containing such an amount of water that when cooled to about 100 deg. F. it will become a thick pasty mass which will just be able to flow? I have consulted various works as have been at my disposal, and am unable to find any reference to the specific heat of sugar or syrup at any stage of its manufacture. A. We would say that we do not know of any exact data giving the specific heat of sugar syrup at different temperatures and different densities. We doubt if such data exist. This specific heat probably does not differ very greatly from that of water. It is a simple matter, however, for you to determine this for yourself by mixing a known weight of syrup at a known temperature with a known weight of water at a lower temperature, stirring the mixture and carefully noting the temperature of the same. It will be necessary for you to allow for the heat given to the vessel containing the water. It would be well for you to use a thin copper vessel for this purpose, because then the heat which it would absorb could be accurately calculated. The formula to use is as follows: (Weight of cool water × weight of copper vessel × .0933) × increase in temperature = specific heat of syrup × weight of syrup × decrease in temperature in syrup. This is a very simple experiment, and if carefully performed, with an accurate thermometer, will give you just what you want.

(9162) F. A. E. says: Does a stationary engineer have to have a license in all States or not? For example, I work in a weaving shop; could I run an engine (stationary) without a license or does the law compel all engineers to have one, stationary and marine? Must I have a license to run a turbine steamer 20 feet long or not in the State of Connecticut? On a former date I wrote to you in regard to alco-vapor engines. You must have misunderstood my meaning. I asked about alco-vapor engine drawings, and you said alcohol motor tests. Please let me know if you have a paper on what I want or if you can tell me where to get it. Could you tell me how to case-harden cast iron and steel? A. A license is required for every stationary engineer in nearly all States of the United States. We do not happen to know of one where none is required. Second, we believe that a license would be required to run a turbine steamer in the State of Connecticut. You can get definite information on this point, however, by addressing the Secretary of State. We do not know what information you desire regarding alcohol vapor engines. So far as we are aware, there are no such engines in this country which are a commercial success. Iron and steel may be case-hardened by heating them to a cherry-red heat, covering them with powdered potassium cyanide, keeping them at this heat for some time with the cyanide continually in contact with the surface of the iron, and then plunging them rapidly into cold water or brine.

(9163) W. M. R. says: Can you give me the name of a substance, not a metal, that is cool, elastic, and tough? Something better than rubber or cork, if you know of such a substance. Will you kindly give me the pull in pounds necessary to straighten a hook made of steel ½ inch broad, 1-16 inch thick and bent to form a loop 5-16 inch in diameter, pull to be exerted by a ring working in the loop? A. It is difficult to answer your question in regard to a substance not a metal, which is cool, elastic, and tough, without knowing the purpose for which you wish to use it. Porcelain is such a substance. Celluloid is another. But possibly neither of these will meet your requirements. The force necessary to straighten out a hook ½ inch wide, 1-16 of an inch thick, bent in the form of a loop 5-16 of an inch in diameter, will be about 180 pounds. This will vary somewhat with the character of the steel. We have figured on an open-hearth steel, with a tensile strength of about 70,000 pounds per square inch. If tool steel were used, the force required would be about twice as great. A factor of safety should be allowed if this is to be used in construction, which would reduce this figure to about ¼ or 1-6 of the amount given above.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

August 18, 1903,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acid in natural phosphates soluble in citric acid, rendering the phosphoric, G. Hoyermann 736,730
Acids, apparatus for condensing and mixing, F. I. du Pont 736,625
Air brake systems, device for heating, J. W. Geary 736,840
Alloys directly from ores, making nickel iron, N. V. Hybinette 736,400
Anticorrosive composition, A. P. Cuthriell .. 736,699
Antifouling composition, A. P. Cuthriell 736,698
Arcs, dirupting, F. E. Case 736,913
Arm rest, G. Smith 736,886
Armature coil, F. A. Merrick 736,417
Ash can, J. W. M. Hipwell 736,396
Astrakhan, imitation, M. Lewin 736,412
Axes, hatchets, or the like, making, A. Schmidt 736,637
Axle lubricator, car, C. R. Cleghorn 736,689, 736,819
Baby jumper, M. B. Davidson 736,826
Baling press, W. R. Colman 736,496
Baling press, J. T. Rodgers, et al 736,550
Baling press automatic folder or tucker, P. and L. Trabue 736,653
Balustrade, K. T. Horn 736,399
Barrel or keg, S. J. Edmiston 736,830
Battery. See Secondary battery.
Bearing, center, J. E. Norwood 736,539
Bed slat fastener, A. N. Webb 736,569
Bedstead fastening, W. S. Walker 736,894
Bell indicator attachment, C. E. Munroe .. 736,616
Belt supporting device, F. R. Willson, Jr.. 736,905
Bench. See Draw bench.
Bending machine, C. Flinn 736,834, 736,835
Benzin pan, Howard & Ungeheuer 736,729
Binder, Blackburn & Swartwout 736,482
Binder, expansion back, E. T. A. Akass .. 736,340
Binder, loose leaf, E. T. A. Akass 736,342
Blackboard, A. E. A. Opitz 736,431
Blast furnace, G. W. Bollman 736,353
Blast furnace, J. C. Cromwell 736,365
Blind stop, C. L. Koenig 736,408
Boat, life, A. Lasserre 736,747
Boat, folding, I. O. Perring 736,623
Bobbin holder, T. J. Murdock 736,617
Boiler, W. D. Boyce 736,354
Book, check, M. P. Exline 736,832
Book rack, pass, M. J. Robinson 736,879
Bottle mouth dust protector, M. Haas 736,719
Bottle, non-refillable, W. S. Palmer 736,434
Bottle stopper, E. A. Nugent 736,430
Bottle stopper, G. West 736,466
Bottle washing and rinsing machine, C. C. Parker 736,769
Bottles, machine for producing glass, T. C. Duffield 736,708
Box filling machine, W. H. Wyman 736,668
Braiding machine, J. Lundgren 736,856
Brake shoe, T. M. Bell 736,350
Brakes, operating electric, F. E. Case 736,914
Brick kiln, C. Cebulla 736,492
Brine cooler, A. H. Hutchinson 736,852
Brooder, I. Morrow 736,423
Broom holder, G. M. Eidt 736,831
Brush appliance, tooth, C. R. Lane 736,607
Bucket, clam shell, J. C. Slocum..736,795, 736,796
Buffing head, F. J. Kane 736,736
Buggy attachment, C. Brown 736,814
Buoy, body indicating, H. Condren 736,692
Bushing expander, G. Staiger 736,647
Buttonhole cutting and stitching machine, E. B. Allen 736,471
Cabinet, kitchen, L. Hockman 736,728
Cameras, focusing view finder for photographic, E. H. Williamson, Jr. 736,899
Can filling machine, P. Mitchell 736,762
Car brake, beamless, J. S. Cary 736,686
Car coupling, automatic, O. C. Moore 736,864
Car couplings, flexible joint for, G. E. Tomlinson 736,892
Car door, W. T. Spillane 736,890
Car draw gear, railway, J. F. Courson, 736,823, 736,824
Car, mine, T. Stagg 736,561
Car, railway, W. S. Glover 736,515
Car stop, C. R. Claghorn 736,691, 736,818
Car underframing, railway, G. I. King ... 736,739
Car unloading apparatus, C. R. Claghorn .. 736,690
Cars, apparatus for controlling the working of electrically driven, A. Siemens ... 736,794
Cars, car strap for street, J. S. Navarro .. 736,620
Carbonating apparatus, H. A. Hopkins, 736,521, 736,523
Carpet cutting machine, J. Silberstein 736,644
Carpet stretcher and tacker, J. W. Quilling 736,873
Carriage seat, folding, J. Broenen 736,355
Carrier. See Package carrier.
Casing spear, E. C. Wilson 736,907
Caskets over the boxes, device for carrying, G. H. Fuller 736,377
Casting mold, chain, Bone & Reid 736,678
Casting solid metallic bodies, B. A. Mick. 736,419
Centrifugal machine electric driving apparatus, L. Hirt 736,397
Chain, F. R. Willson, Jr. 736,904
Chair, G. A. Dutton 736,709
Chair, D. R. Cotner 736,822
Check hook and rein piece, T. L. Cooper. 736,493
Chimney top and ventilator, J. F. Le Beau 736,748
Cigar case, O. L. Parmenter 736,770, 736,771
Cigarettes or like goods, machine for packing, A. Godfrey 736,592
Circuit breaker, T. E. Daniels, Jr. 736,502
Circuit breaker for jump spark coils, A. H. Deisher 736,703
Clipper, hair, W. J. Long 736,854
Clothes drier, W. A. Kester 736,603
Clothes drying apparatus, D. P. Prescott ... 736,777
Clothes stick or lifter, T. F. Condon 736,497
Clothes washer, S. A. Newcomer 736,870
Clover buncher, J. K. Sharpe, Jr. 736,450
Clutch, C. L. Grohmann 736,517
Clutch, electromagnetic friction, W. Schuster and H. Ast 736,789
Coat, M. Wenzel 736,654
Coffee, treating, W. E. Baker 736,346
Concrete and metal construction, J. Kahn .. 736,602
Conveyor, F. R. Willson, Jr. 736,901
Conveying apparatus, F. R. Willson, Jr., 736,902, 736,903
Copy holder, A. J. Harpole 736,848
Core making machine, W. M. McCallum 736,618
Corn husker ear agitating guide, J. V. Ross 736,785
Corn sheller, A. R. Montgomery 736,615
Corn shocker, P. C. Knutson 736,526
Cornet, H. C. Martin 736,756
Crank and crank connection, T. L. & T. J. Sturtevant 736,457
Cream separator, H. D. Zehrbach 736,570
Cultivator, H. M. Phillips 736,872
Curtain bracket, adjustable, Wiggins & Quittmeyer 736,467
Curtain clasp and holder, window, R. F. Murray 736,867
Curtain fixture, window, C. E. Heinrich .. 736,391
Curtain pole socket, W. B. McCarthy 736,619
Cut off and self cleaning filter, automatic cistern, A. B. B. Harris 736,388
Cut out, Hall & Eldridge 736,598
Cycle safety apparatus, A. Kuhn 736,409
Dampening and ironing machine, combined, T. S. Wiles 736,661

Dampening machine, T. S. Wiles 736,660
Damper regulator, electric, A. M. Butz.... 736,490
Demijohns or similar receptacles, covering for, G. Porta 736,626
Developing photographic pictures, Fischer & Guntrum 736,374
Disk drill, double, Dynes & Pierce..... 736,369
Disk drill, single, J. M. Pierce..... 736,440
Display rack, curtain, J. A. Gemmill..... 736,379
Ditching machine, F. J. Beckley..... 736,348
Dock, floating, H. F. Hansson..... 736,725
Dock, floating, H. Hylander..... 736,732
Door check, J. F. Scott..... 736,639
Door check and closer, combined, Hills & Gross 736,850
Door, combined screen and storm, L. J. R. De Vries 736,802
Door hanger, sliding, J. A. Einfalt..... 736,510
Door mat, H. J. H. Bruhn..... 736,358
Door opener and holder, J. D. Gendron.... 736,714
Doors, overhead track covering for outside, J. E. Whitacre..... 736,656
Draft and buffing mechanism, P. T. Handiges 736,724
Draw bench, Lamb & Griggs..... 736,605
Drawing press, F. C. B. Page..... 736,433
Drills. See Disk drill.
Drill press attachment, H. N. Hinckley.... 736,395
Driving mechanism, C. Stollewerk..... 736,564
Dye and making same, blue sulfur, R. Gley. 736,380
Dye and making same, indigo blue sulfur, Kaltwasser & Gaumer..... 736,403
Easel, sketching, S. H. Esbjorn..... 736,589
Eccentrics, adjustable strap for, W. Harling 736,847
Educational material, W. Seegmiller..... 736,448
Electric brake, F. E. Case..... 736,817
Electric cable, Bennet & Johansson..... 736,351
Electric furnace or oven, A. Eimer..... 736,509
Electric machinery, dynamo, H. Chitty.... 736,362
Electric machine, field winding, E. Ziehl.. 736,910
Electric motor and brake, A. A. Thresher.. 736,461
Electric motor controller, W. H. Chapman.. 736,493
Electric operating apparatus, means for controlling, K. Hertwig..... 736,393
Electric sectional furnace, A. Eimer..... 736,917
Electric switch, W. M. Scott..... 736,447
Electric transmission system, R. A. Ripley 736,548
Electric trip mechanism, Ely & Kobelt.... 736,511
Elevator shaft safety guard, W. Sheridon.. 736,642
Embroidery machine, F. P. Ledreux..... 736,612
Engine, J. J. E. Phillips..... 736,438
Engine sparking igniter, explosive, A. A. & D. E. Karcher..... 736,737
Engines, balanced piston for steam, D. E. Rice 736,781
Engines, electric igniter for internal combustion, L. Jones..... 736,734
Engraving machine, three dimension, M. Barr 736,475
Envelope, P. E. Johannsen..... 736,853
Fan fly, F. R. Womeldorf..... 736,469
Fare register operating device, B. B. Moad 736,861
Feed mechanism, automatic, White & Duryea 736,896
Feeder, boiler, Davis & Ault..... 736,702
Feeding apparatus, shell head, F. W. Olin.. 736,622
Fence machine, wire, G. W. Whittington. 736,658
File attachment, binding, E. T. A. Akass.. 736,339
File, binding, E. T. A. Akass....736,338, 736,343
File, document, B. R. Porter..... 736,776
Filter, barrel, C. D. Grove..... 736,597
Filters, cleaning, T. J. Zoeller..... 736,669
Fire alarm, electric, G. B. Martin..... 736,755
Fire box sheet, J. Conroy..... 736,693
Fire escape, M. O. Barke..... 736,347
Fire extinguisher, automatic, E. G. Gay.... 736,514
Fire protecting door for air or elevator shafts, H. Fischer..... 736,711
Fire shovel, H. C. Stiefel..... 736,798
Fish line reel, E. D. Rockwell..... 736,880
Floor scraper, E. Gaulette..... 736,594
Flue cap, J. McIntyre..... 736,537
Flushing apparatus, F. N. Dixon..... 736,504
Fly trap, E. F. Davison..... 736,827
Fodder shredder cleaning device, C. E. Curtiss 736,501
Folding box, M. Hirsch..... 736,727
Folding case, J. J. O'Brien..... 736,871
Formaldehyde compound, R. Lepetit..... 736,529
Foundations and tunnels or other structures, constructing, C. Sooysmith 736,560
Fruit drier, G. W. Henkle..... 736,849
Fruit picker, M. Aksila..... 736,671
Furnace, J. E. Langford..... 736,746
Furnace air and steam feeding attachment, boiler, G. Marlow, Sr..... 736,857
Furnace bell gear, blast, Cromwell & Koelkebeck 736,366
Furnace charging car, blast, G. W. Bollman 736,352
Furnace grate bars, apparatus for shaking, J. A. Normand et al..... 736,768
Gage. See Water gage.
Garment, W. G. Turner..... 736,893
Garment fastener, H. Booth..... 736,811
Garment supporter, H. T. Vaders..... 736,567
Gas engine, direct acting, P. Gervais..... 736,715
Gas generator, acetylene, J. M. & P. M. Flugstad 736,836
Gas generator, water, Schill & Hills..... 736,636
Gas tip, W. Kramer..... 736,604
Gas valve water seat, E. Bumford..... 736,488
Gate attachment, automatic, F. H. Warne. 736,568
Gear, changeable speed, W. L. Marr..... 736,415
Gearing, variable speed, F. L. Todd..... 736,462
Girder, etc., concrete and iron, R. Grimm 736,718
Glass mold, A. B. Scott..... 736,790
Glazier's tool, L. J. Klemm 736,741
Gold washing machine, Turner & Stewart. 736,464
Goods holding and displaying device, G. W. Boyd 736,813
Governor, G. B. Petsche..... 736,542
Governor, marine engine, I. Corneliussen... 736,363
Grain bagging and weighing machine, J. B. Williams 736,663
Grain drill gearing, C. H. Pelton..... 736,436
Grain separator, P. Eagen..... 736,370
Graphite, purifying, M. F. R. Glogner..... 736,381
Grinder, tool, R. C. Greenerd..... 736,843
Grinding machine tool holder, J. Bath..... 736,573
Grinding mill, F. E. Whitham..... 736,657
Guiding systems, apparatus for ascertaining position relative to prearranged, R. B. Owens 736,432
Gun, field, E. K. Rothe..... 736,881
Hame and trace hook, J. B. Gathright.. 736,839
Hammer, G. J. Steele..... 736,797
Hammer or hatchet magazine, F. S. Vogue 736,465
Harness hanger, J. Reichert..... 736,877
Harvester, corn, G. D. Foster....736,590, 736,591
Harvesting or husking machines, snapping rolls for corn, B. R. Benjamin..... 736,478
Hat and coat rack, E. Pratt..... 736,442
Hat, coat, and umbrella holder, P. Hufeland 736,731
Hat rack or hanger, J. G. White..... 736,806
Hatch, H. Brousseau 736,357
Hay rake, stacker, and loader, J. A. & O. J. Smith 736,558
Head rest, W. N. Greer..... 736,844
Hens from setting, means for preventing, J. B. Copeland 736,821
Hive frames, foundation fastener for, O. O. Bordson 736,679
Hoisting machine, W. A. Barker..... 736,572
Holder, F. W. Matson..... 736,531
Hooks and eyes, carrier for machines for carding, J. W. Granger..... 736,717
Horses or other animals on shipboard or other places, apparatus for exercising, N. Burgess 736,360
Hose coupling, C. Wright..... 736,908
Hose supporter, C. E. Schaffner..... 736,788
Hot air registers, vaporizing device for, L. C. Wilcox 736,659
Ice cream cabinet, H. A. Hopkins..... 736,522
Ice cream freezer, C. R. Hamilton..... 736,723
Ice spur, L. Winterhalder..... 736,468
Initiating apparatus, E. & U. S. De Moulin 736,704
Internal combustion engine, C. A. Wilkinson 736,807
Jack o'lantern, folding, J. J. Du Ket..... 736,506
Jars, tools for removing screw caps from, F. L. Stork 736,455
Journal bearing, I. Metzger 736,532
Kiln. See Brick kiln.
Knee pad, scrubwoman's, W. Steers, Sr.. 736,648
Labeling machine, J. T. Reames..... 736,546
Ladder, foldable fruit, S. S. Ward..... 736,804
Ladder, metallic step, W. H. Cloud..... 736,495
Lamp, alcohol, J. P. Steppe..... 736,454
Lamp burner, flat wick, W. C. Quigley.... 736,545
Lamp, gas, T. Brabson..... 736,681
Lamp socket, W. A. Church..... 736,577
Lamp support, S. Camins..... 736,685
Lamps, automatic apparatus for extinguishing, P. E. Newsom..... 736,538
Lantern holder and protector, G. F. Kibling 736,405
Latch, automatic, Drucker & Haensler..... 736,707
Lathe, Search & Cheshire..... 736,791
Lathe, turret, Search & Cheshire..... 736,792
Ledger and compressor, loose leaf, E. T. A. Akrass 736,341
Legging fastening, L. H. Morgan..... 736,764
Lime and gas, manufacture of, J. J. McTighe 736,869
Linoleum, machinery for manufacturing patterned, P. Blaubach..... 736,676
Liquid delivery case and cooler, C. E. Flinder 736,916
Liquid fuel burner automatic regulator, A. C. Stewart 736,563
Loading device, W. E. Hamilton..... 736,385
Loading machine, W. E. Hamilton..... 736,846
Lock, G. Lenhard 736,528
Loom or frame for beadwork, T. F. Damm.. 736,701
Loom pattern chain, J. T. Cyr..... 736,700
Loom reed, G. de Zorawski..... 736,670
Loom shuttle, Coldwell & Gildard..... 736,580
Loom shuttle automatic threading device, R. L. Cumnock..... 736,500
Looms, machine for soldering healds for weaving, J. Gohy..... 736,593
Lubricating device, bearing, J. D. Forrer 736,376
Mail receptacle, J. P. Brown..... 736,815
Mailing tube, J. C. Kimsey..... 736,407
Mathematical device, S. N. Betts..... 736,481
Measuring tape, F. Buck..... 736,359
Merry-go-round, J. M. Sherman..... 736,643
Metal cutting machine, J. H. Doub..... 736,505
Metal shearing machine, C. McDonner..... 736,536
Metal working tool, A. Tindel..... 736,799
Metals, dry separator for, T. M. Moe..... 736,862
Metallic fabric, R. S. Brown 736,485, 736,486
Metallic tie and rail fastening, V. A. Showalter 736,885
Milk jar closure, J. Crane, Jr..... 736,694
Milling machine, C. P. Higgins..... 736,726
Minerals, locating, G. I. Leonard..... 736,411
Mining machine, H. B. Dierdorff..... 736,705
Mirror, rear view hat, L. D. Merrick..... 736,418
Mirror support, adjustable, C. N. Langdon.. 736,609
Miter box, A. P. Forsling..... 736,837
Mixing and washing machine, T. Haskins.. 736,389
Molding machine, E. A. Goepper..... 736,841
Motor control system, electric, Dunn & Douglas 736,587
Motors from a distance, electrically controlling, W. Baxter, Jr..... 736,476
Mower knife head, L. B. Mitchell..... 736,761
Multivoltage system, C. E. Woods 736,667
Music playing instruments, accentuation mechanism for autopneumatic, Hosley & Harcourt 736,600
Music roll perforating device, H. P. Ball.. 736,571
Nailing machines, reel for holding wire in, S. M. Cutter..... 736,825
Nut lock, Strohmenger & Clancy..... 736,456
Nut, locking, M. E. Donally..... 736,368
Oil burner, E. M. Arnold..... 736,473
Oil burner, T. Williams..... 736,664
Oil burner nozzle, Brunner & Patterson... 736,487
Oil can acoustic alarm, J. A. Pollock.... 736,441
Ore dumping apparatus, N. A. H. Salomonson 736,882
Osmose apparatus, J. L. Kubin 736,745
Package carrier, E. F. Priddat 736,631, 736,632
Package fastener and carrier, E. F. Priddat 736,630
Package safety holder, E. M. Reed..... 736,779
Package tie fastener, F. M. Crawford..... 736,499
Paper bag machine, P. L. Bartholomew.. 736,673
Paper blank cutting mechanism, Robinson & Williams 736,783
Paper cartons, machine for lining, L. G. Reynolds 736,780
Paper cord making machine, H. B. Morris.. 736,422
Paper making machine, J. Grondahl..... 736,596
Paper perforator, W. S. Mendenhall..... 736,614
Paper roll adapted to be cut into blanks, Robinson & Williams..... 736,784
Parachute, dart, R. W. Means..... 736,759
Peat digging and conveying machine, C. F. Schlickeysen 736,446
Pen, fountain, W. I. Ferris..... 736,710
Pen and pencil receptacle tablet, combination, W. H. Wymans..... 736,810
Petroleum, deodorizing or purifying, F. Berg 736,479
Petroleum deodorizing or purifying apparatus F. Berg..... 736,480
Photographic tray, G. T. McKinney..... 736,766
Piano action flange, G. M. Guild..... 736,384
Piano pedal action, R. M. Bent..... 736,675
Piano tuning pin cover, I. B. Rosencrantz. 736,552
Picker. See Fruit picker.
Picker staff and shuttle check, combined, Coldwell & Gildard.....736,581, 736,582
Pile driver, N. Simonson..... 736,452
Pin, M. Rhoades..... 736,547
Pipe wrench, A. Fasenmeyer..... 736,372
Pipes, clamp or device for stopping leaks in, Pitkethly & Hayes..... 736,624
Piston, J. C. Junkin..... 736,735
Piston rods, bearing for steam feed, H. G. Dittbenner 736,367
Pitman, T. L. & T. J. Sturtevant..... 736,458
Planter and fertilizer distributor, seed, J. A. McCutchen 736,425
Plow, C. R. Davis..... 736,503
Plow jointer or rolling colter, W. R. Crifield 736,695
Plow point, J. Halman..... 736,845
Plow, sulky, G. Wilkinson..... 736,662
Pneumatic tube, L. G. Bostedo..... 736,680
Pocket knife, E. Kaufmann.....736,524, 736,525
Pole socket, vehicle, H. E. Martin..... 736,858
Pool ball registering triangle, E. J. Wells.. 736,805
Port light, C. F. Petersen..... 736,772
Portable elevator and dump, J. & D. Fisher 736,833
Post hole forming implement, H. D. Sorg 736,645
Powder puff, Rowland & Hull..... 736,786
Printing, C. Owens..... 736,540
Printing press perforating attachment, Emrich & Krautter..... 736,512
Pruning shears, E. Mohr..... 736,763
Pump, E. T. Miles & Z. Storch..... 736,421
Pump, air, L. E. Hoffman..... 736,398
Pump, air, W. M. Reason..... 736,778
Pump bail, sand, R. Crytser 736,696
Pump stroke regulator, windmill, Lowrie & Votaw 736,530
Pumping device, F. L. Robertson..... 736,549
Pumping engine, C. J. Printz..... 736,443
Punching apparatus, strip, A. Pollak..... 736,775
Puzzle, D. McPherson..... 736,767
Quartz mill, C. J. Hodge..... 736,519
Rail joint, W. C. Scofield..... 736,883
Railway or tramway vehicles, brake apparatus for electric, J. G. V. Lang..... 736,608
Railway rail and rail joint, J. Teller..... 736,566
Railway signal, J. G. Schreuder..... 736,554
Railway signal, automatically operated, I. Reynet 736,445
Railway signal, electric, Ammann & Campbell 736,345
Railway switch, F. W. Aley..... 736,911
Railway system, electric, T. Mahoney..... 736,752
Railway vehicles, reversing apparatus for use on, J. Graber..... 736,382
Rake, K. Reis..... 736,878
Range finder, electrical, H. Shoemaker.... 736,557
Razor guard, J. J. Meehan..... 736,859
Reach and short turning gear, interchangeable, F. C. Kerby..... 736,738
Receptacle, C. O. Harker..... 736,387
Receptacle for corned beef, etc., W. G. Bell 736,349
Recording device, J. A. Cole..... 736,583
Refrigerator drawer, Shanklin & Hausam.. 736,449
Resistance tube, C. Bloom..... 736,677
Roasting pan, E. H. Moore..... 736,863
Rock drill, C. Mead..... 736,758
Roller. See Shade roller.
Rotary engine, J. Graves..... 736,383
Rotary engine, R. B. Morden..... 736,865
Rotary explosive engine, J. J. O. R. Rulianch 736,787
Rubber heel, F. M. Hilton et al..... 736,394
Rule, protractor, A. Peterson..... 736,437
Sack holder, J. Schmidt 736,553
Sad iron, C. W. Johnston..... 736,733
Saddle, harness, C. W. Miller..... 736,760
Sash fastener, E. H. Baker..... 736,474

(Continued on page 158.)

Sash, store front, J. B. Phelps	736,774
Sausage stuffing machine, E. Hahn	736,720
Saw set, J. Morin	736,534
Saw set and gage, combined, D. Worden	736,470
Scalper, grader, and purifier, Craig & Gunnell	736,364
Scow, dumping, B. Seaman	736,640
Screw nail, T. B. Hitchman	736,851
Seal, snap, E. J. Brooks	736,682
Seat support, G. Wilson	736,665
Secondary battery, G. E. Hatch	736,390
Secondary battery, J. Middleby, Jr	736,420
Sewing machine, G. H. Dimond	736,828
Shade and curtain support, combined, C. S. Snell	736,559
Shade, artificial light, O. A. Mygatt	736,535
Shade bracket, adjustable, M. H. Middlemiss	736,533
Shade roller, W. Mumbrauer	736,424
Shaft and harness support, F. D. Davies	736,915
Shaft support, E. R. Edson	736,508
Shafting, flexible, G. E. Gay	736,378
Sharpener, disk, J. S. Donnell	736,829
Shoe fastening, E. L. Knapp	736,742
Sign, illuminated, W. M. Hall	736,722
Signaling, electrical, Shoemaker & Snook	736,884
Signature bundling machine, S. H. Pray	736,627
Skirt, S. H. Camp	736,576
Sleigh, W. C. Pierce	736,543
Snowboat, S. S. Hansen	736,386
Soap press, C. Diolet	736,706
Soap wrapping machine, J. E. Robinson	736,634
Solder, R. Bormann	736,812
Solder for aluminium, Fortun & Semprun	736,712
Sound producing device suitable for sirens or like instruments, J. P. Northey	736,428
Sound record cylinders, forming metal matrices for duplicating, A. N. Petit	736,773
Spanner or wrench, J. Chandler	736,687
Spinning spindle, J. C. Potter	736,544
Spinning spindle bolster and step combined, J. Caldwell	736,491
Spool holder, C. T. Starr	736,562
Sprocket wheel, F. R. Willson, Jr	736,906
Stacker, straw, A. M. Hood	736,599
Starching machine, J. Huebsch	736,601
Steam boiler, M. O'Connor	736,621
Steam boiler, H. L. Fulenwider	736,713
Steam drier, C. H. Noyes	736,429
Steam engine, W. M. Smith	736,888
Steam generator, V. Taboulevitsch	736,652
Steam generator water gage, A. Wood	736,666
Steam generator, water tube, H. W. Kolle	736,743
Steam power apparatus, P. L. Clark	736,579
Steam power plants, operating, P. L. Clark	736,578
Steam trap, F. W. Leuthesser	736,750
Steam trap, T. J. Grace	736,842
Steel, etc., apparatus for making, E. C. Wills	736,900
Stool, foot, R. M. Niderer	736,427
Store service apparatus, M. C. Swezey	736,651
Stove, G. J. Day	736,585
Stove attachment, M. J. Stevens	736,649
Stove cover and lifter, L. T. Lenderking	736,749
Stove, gas heating, E. Meininghaus	736,860
Stove, heating, C. J. Kirch	736,740
Stovepipe holder, W. H. Medina	736,416
Submerged devices, means for protecting, O. A. Stemmel	736,891
Sucker rod connector, F. M. Egbert	736,371
Sugar mixing apparatus, Ragot & Tourneur	736,875
Sugar, press for pressing the parings of diffusion chambers in the manufacture of, W. Bock	736,484
Sulfuric anhydrid, making, Raynaud & Pierron	736,876
Sun shield, R. L. Morgan	736,765
Superheating apparatus, M. W. Sewall	736,793
Surgical ecraseur, L. R. Kratzmueller	736,744
Switch. See Electric switch.	
Tag stringing machine, J. C. Kimsey	
Tank, A. Holtgen	736,52
Tank heating apparatus, E. O. Whittington	736,898
Tank mold, J. C. Dougherty	736,586
Telegraph signals, determining the direction of space, J. S. Stone, reissue	12,148
Telegraphic transmitting and receiving apparatus, G. F. R. Blochmann	736,483
Telephone, J. A. Barrett, et al	736,672
Telephone apparatus, C. G. Burke	736,489
Telephone paper holding device, W. H. Sherman	736,556
Telescopic sights, means for adjusting cross hairs of, A. W. Peterson	736,541
Tie, E. F. Priddat	736,628
Tie fastener, E. F. Priddat, reissue	12,147
Tie fastener, E. F. Priddat	736,629
Tile and roof, roofing, J. Veen	736,801
Tire, W. P. Scofield	736,638
Tire, pneumatic, P. W. Litchfield	736,414
Tire, pneumatic, W. Corliss	736,584
Tobacco pipe attachment, T. C. Martin	736,757
Tongs, M. Quinn	736,874
Tool, combination, J. Parbel	736,435
Tool, pneumatic, C. H. Shaw	736,555
Tooth cleaning appliance, J. E. Storms, Jr	736,650
Toy, whistling, C. D. Robb	736,782
Track sanding device, J. H. Watters	736,895
Train control system, F. E. Case	736,816
Trains, device for delivering messages to moving, A. U. Campbell	736,361
Transparency, J. Lobmiller	736,751
Transport of materials, apparatus for the, H. Marcus	736,753
Trimming making machine, J. A. Groebli	736,595
Trolley, Lavagne & Bertrand	736,610
Trolley, Seastrunk & Archer	736,641
Trolley, E. Hall	736,721
Trolley, A. P. Lord	736,855
Trolley catch, White & Duryea	736,897
Trousers hanger, J. Nagely	736,426
Truck, J. P. Lind	736,613
Truss, M. B. Brooks	736,356
Tube making fagot, W. Allderdice	736,314
Tunnel section, H. F. Dunham	736,507
Type expander, J. J. Cain	736,684
Typewriter, W. Baxter, Jr	736,477
Typewriter type bar, J. A. Smith	736,887
Type writing machine, R. D. Stackpole	736,646
Umbrella support, W. M. Feazell	736,373
Valve gear for compound locomotive engines, W. M. Smith	736,889
Valve, pipe line, C. E. Fowler	736,513
Valve, pop safety, J. Collis	736,820
Vehicle driving gear, motor, E. E. Wright	736,909
Vehicle driving mechanism, P. Synnestvedt	736,459
Vehicle heating apparatus, G. F. Ray	736,633
Vehicle lantern holder, G. F. Kibling	736,404
Vehicle, motor propelled, J. Munden	736,866
Vehicle reservoir, motor, Charron & Girardot	736,494
Vehicle runner, wheeled, S. J. & J. D. Phillips	736,439
Vehicle wheels, antiskidding device for, S. Butler	736,683
Velocipede frame, E. G. Latta	736,527
Voting machine, Turner & Anderson	736,463
Wagon running gear, J. E. Bennett	736,674
Wall construction, W. H. Fisher	736,375
Washing machine, M. J. Lawler	736,410
Washing machine, F. E. Waldby	736,803
Washstand, cabinet, J. B. Wheatley	736,655
Watch case, A. Bilat	736,574
Watch fob, W. H. Lamb	736,606
Watch protector, C. R. Tetzner	736,460
Water by electrolysis, decomposing, W. F. M. McCarty	736,868
Water closets or other structures, flushing tank for, W. U. Griffiths	736,516
Water controlling device, E. J. Markel	736,754
Water gage, M. Hering	736,518
Water heater, W. E. Vanstone	736,800
Water, purifying, J. E. C. L. Putzeys	736,444
Water repellent, machine for treating fabrics for rendering them, C. Lichtenstadt	736,413
Water trap for waste pipes, F. B. Charrion	736,688
Water tube boiler, G. Silvestri	736,451
Weather strip, J. W. Henry	736,392
Well drilling machinery, G. A. Gilborne	736,716
Wheels and pulleys, manufacture of, E. Roemer	736,551
Wheelbarrow, E. M. Cummins	736,697
Winding machine, C. Anderson	736,472
Winding mechanism, ball, F. W. Worrill	736,809
Window sill, C. L. Edmonds	736,588
Wire stretcher clamp, Socks & Smith	736,453
Wood preservative, H. W. Gander	736,838
Woodworking tool, Blandford & MacGregor	736,575
Worsted box, G. M. Wooster	736,008
Woven fabric and producing same, W. Rumpf	736,635

(Continued on page 159.)

Wrench, J. G. Campbell 736,912
Yeast, preparation of, G. Jacquemin 736,401
Yeast, preparing, G. Jacquemin 736,402
Zinc from its ores, extracting, C. G. P. de Laval 736,611
Zincing objects by electrolysis, I. Szirmay. 736,565

DESIGNS.

Automobile body, L. B. Gaylor 36,508
Badge, K. Melrose 36,495
Badge or similar article, R. M. Crawford ... 36,496
Braid, C. Schwarcz 36,509
Candelabrum, A. H. Heisey 36,500
Desk and seat support or standard, J. Dux .. 36,506
Doily or similar article, J. W. Catty. 36,510, 36,511
Fabric, decorative, H. Giebel 36,513
Lighting fixture shell, H. E. Watkins, 36,501 to 36,504
Plate, dish, or similar article, C. E. Haviland 36,505
Radiator, E. V. Seeler 36,507
Spoons, forks, or similar articles, handle for, W. R. Stocking 36,498
Spoons or similar articles, handle for, Crees & Court 36,499
Table cloth, J. A. Steinau 36,512
Watch charm or simliar article, F. L. Schmalz 36,497

TRADE MARKS.

Antiseptic and disinfecting compound, Telephonine Company of America 40,961
Beer, Wm. J. Lemp Brewing Co 40,948, 40,949
Beverages for certain named purposes, Midnight Mineral Water Company 40,950
Blouses, coats, overalls, and pants, Standard Mfg. Co. 40,928
Butter, Hanford-Hazelwood Cream Co 40,953
Butter, J. R. Denman 40,954
Candies, chocolates, and candied productions, James A. McClurg & Sons, Inc 40,943
Clay pigeons, W. S. Dickey 40,970
Cleaning compound, cream colored, McLeod & Froom Grocery Co 40,964
Compound for certain named purposes, R. L. Odom 40,959
Disinfectant, Edson Manufacturing Co 40,962
Envelops, United States Envelope Co 40,924
Figs, A. Hamparzum 40,942
Files, Melchior, Armstrong & Dessau 40,974
Flour, Hecker-Jones-Jewell Milling Co 40,937
Flour, certain named, F. B. Chamberlain Co. 40,938
Flour, wheat, L. M. Paschall 40,936
Food and remedies, poultry, G. L. Harding. 40,956
Fruits and vegetables in packages, Havey, Lockie & Co 40,935
Gelatin, Swampscott Gelatine Company 40,944
Hair fastening and supporting articles, certain named, E. F. Blodgett 40,925
Harness saddles, harness straps, bridles, and halters, W. T. Wroe & Sons 40,969
Hats, straw, Duke, Montague & Gillet Co .. 40,927
Headache cures, J. D. Sutton 40,957
Knives, belt knives, and leather knives, machine, Bailey & Blendinger Mfg. Co 40,972
Leather, imitation, Marokene Co 40,931
Liquids for certain named purposes, mixed, L. S. Van Westrum 40,967
Matches, safety, H. Hochberg 40,963
Medicines for cure of certain named diseases, C. Weschcke 40,953
Milk, condensed, Wisconsin Condensed Milk Company 40,952
Polishing preparation for certain named purposes, Ever-Brite Co 40,965
Potatoes, sweet and Irish, Eastern Shore of Virginia Produce Exchange 40,934
Poultry, crushed shell for, Boepple Button Company 40,955
Powder, antiseptic astringent, L. Feeser 40,960
Pulleys or blocks, Boston & Lockport Block Company 40,971
Relishes, certain named, Lutz & Schramm Company 40,941
Ribbons, Brown, Durrell & Co 40,932
Shirts, Richardson, Roberts Dry Goods Co .. 40,929
Shoes, leather, Siegel-Cooper Company 40,930
Silverware, certain named, W. B. Kerr & Co. 40,926
Stove and metal polishes, C. H. Gerbig 40,966
Tea, Robinson & Woodworth 40,951
Varnish and hard oil finish, Spokane Paint & Oil Co 40,968
Vehicle wheels, metallic rims for, Clincher Automobile Tire Manufacturers Association 40,973
Wheat flakes, Seeman Bros 40,939
Whisky, W. J. Smith Co .... 40,945 to 40,947
Yarns, Brown, Durrell & Co 40,933
Yeast, A. J. Priest 40,940

LABELS.

"B B S," for medicine, W. N. Bailey 10,256
"Barberie's Furniture Polish," for furniture polish, J. J. Barberie 10,261
"Bright Shear Blue," for horse nails, Standard Horse Nail Co 10,281
"Castle Haven Brand Tomatoes," for canned tomatoes, Johnson & Radcliffe 10,266
"Chave's Cholera Cure," for medicine, T. T. Chave 10,258
"Dr. Caldwell's Femitone," for medicine, G. W. Caldwell 10,257
"El Trado," for cigars, Schmidt & Co 10,278
"Elk's Home Brand Tomatoes," for canned tomatoes, H. M. Johnston 10,267
"Enamel Pointed Pen," for pens, H. A. Hill 10,280
"F. Garcia & Bros. Fabricantes De Tabacos Habana," for cigars, F. Garcia & Bros. 10,275
"Indian Head Cape Cod Cranberries," for cranberries, H. J. Thayer 10,268
"Ish-Allah," for coffee, M. Horovitz 10,270
"Ish-Allah Coffee," for coffee, J. Kurzban. 10,271
"La Corrida de Toros," for cigars, Schmidt & Co. 10,279
"Lorithia," for mineral water, Andrew Lohr Bottling Company 10,272
"Lowney's Gold Medal Chocolate Powder," for chocolate powder, Walter M. Lowney Company 10,269
"Major Lark," for cigars, J. Mendel & Co. 10,276
"Mutual," for groceries, Mutual Grocery Corporation 10,264
"Nevadoe," for cigars, Schmidt & Co 10,277
"Old English Varnishes," for varnish, Norton Paint & Hdw. Co 10,260
"Once—Always," for groceries, Mutual Grocery Corporation 10,263
"Purina Cream Graham," for cereal products, Ralston-Purina Co. 10,265
"Rim Standardized by the Clincher Automobile Tire Manufacturers Association." for wheel rims, Clincher Automobile Tire Manufacturers Association 10,282
"The Beer of Quality," for lager beer, A. von Cotzhausen 10,273
"The Illinois Boiler Cleaning Compound," for boiler cleaning compound, W. Rice .. 10,262
"The 'Ounce of Prevention,'" for medicine, M. T. Fulcher 10,259

PRINTS.

"College Styles," for men's winter apparel, David Adler & Sons Clothing Co 806
"The Adler Fall Fashions," for winter apparel, David Adler & Sons Clothing Co. 805

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

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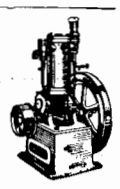

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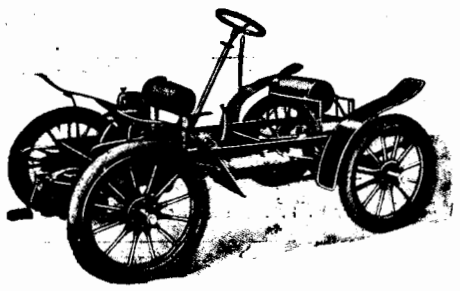

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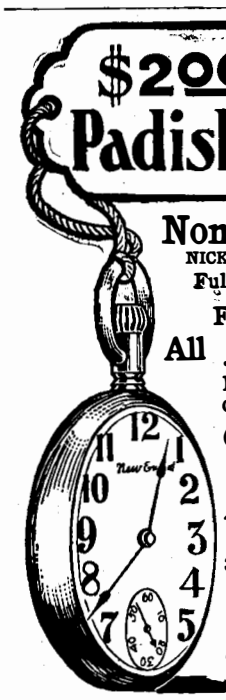

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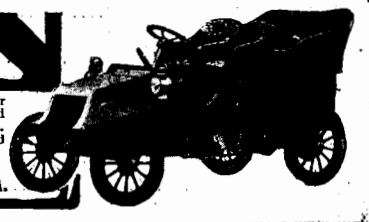

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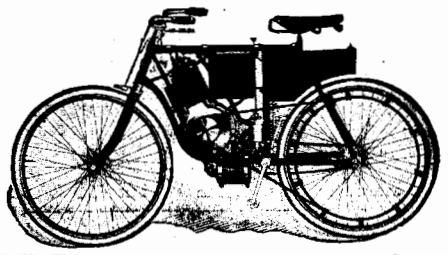

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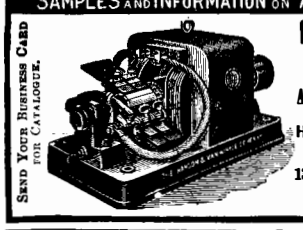

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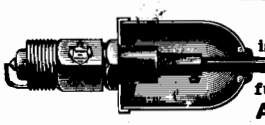

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