of fish, and some animals, chiefly belonging to the Eocene, Pliocene, or post-Pliocene ages.

Very careful analysis of a large number of the samples of land rocks taken from the pits above described, made in my laboratory, under my own supervision, gave, after being well dried at 212° F., the following averages:

Moisture, water of combination, and organic matter lost on ignition.	8:00
Phosphate of lime	57.68
Carbonate of lime	8.68
Phosphate of iron and alumina	6.60
Carbonate of magnesia	0.78
Sulphuric acid and fluorine	1.80
Sand, siliceous matters and undetermined	10.64
	100:00

These figures suffice to show that the grade of this phosphate is not extremely high, but it is admirably adapted for the purpose of manufacturing commercial fertilizers, and will, therefore, long continue to maintain a leading position as a raw material in the markets of the world.

Before it can be made available for industrial purposes, it is made to pass through three distinct and successive operations: 1. Mining or excavating. 2. Washing it free from sand and other impurities. 3. Kilning, to free it from moisture. Taking these in their order, it is customary to establish a main trunk railroad starting at the river front, or on the bank of some convenient stream, and passing right through the center of the property to be exploited.

Alternate laterals can be run off at right angles from any portion of this main line, at distances of say 500 feet, in conformity with the nature of the ground. Between and parallel to these laterals, a ditch or drain is dug to a depth extending 4 or 5 feet below the phosphate strata. From this main drain the excavators start their lines at right angles to the laterals, commencing at one end of the field and digging trenches 15 feet wide and 500 feet long, the work being so arranged that the men are stationed at intervals of 6 feet. Every man is supposed to dig out, daily, "a pit" 6 feet long, 15 feet wide, and down to the phosphate rock. The overlying material is thrown out to the left hand side of the trench. The phosphate itself is thrown out to the right, and taken in wheelbarrows to the railroad cars which pass at either end of the trench. The water drains from the trenches into the underlying ditch, and is then e pumped out by means of a steam pump worked by a locomotive engine. The pump and the engine are

secured to connected railway platforms, and run along the railroad track, from one ditch to another, as occasion requires. The cars, loaded with the crude phosphatic material dug out of the pits, are run down to the washing apparatus, constructed at an elevation of some 30 feet from the ground, and generally consisting of a series of semicircular troughs 20 to 30 feet long, set in an iron framework at an incline of some 20 inches rise in their length.

Through every trough passes an octagonal ironcased shaft, provided with blades so arranged and distributed as to form a screw with a twist of one foot in six, which forces the washed material upward and projects the fragments against each other. The phosphate laden cars are hauled up an incline and their contents dumped into the bottom trough, where the phosphate encounters one or more heavy streams of water, pumped up by a steam pump. This water does not run off at the bottom, but overflows at the higher end near where it enters. When sufficiently washed, the phosphate is pushed out upon a one-half inch mesh screen; the small debris being received on oscillating wire tables below. It is now ready for kilning or drying, and of all the methods hitherto adopted for this important process, that of simple burning or roasting, in an ordinary kiln, such as is generally used in the manufacture of bricks, has been found at once the most rapid, effective and economical.

The rock is built on layers of pine wood, and owing to its containing a considerable quantity of organic matter, it readily lends itself to combustion and requires but a short time to become quite red hot.

The kilns are made sufficiently large and so arranged as to allow free passage to a train of cars, which, running on the main line of railroad, can be loaded in the kiln, run down to the landing place, and discharged directly into the barges or boats on the river. With a properly constructed plant, regular drainage, and efficient management, the total cost of producing one ton of South Carolina phosphate in clean, dry, marketable condition is about \$3.50 per ton, made up as fol-

Mining, at a maximum depth of 15 feet	\$1.00
Draining the mine	25
Loading on cars and carrying to washer	60
Washing	30
Drying and handling in kiln	50
Shipping from kiln into vessels on river	25
Interest on capital invested in plant and repairs to same	15
Superintendence and management of mines	20
Towage to Charleston, say	25
Total per ton of 2.240 lb	\$ 3.50

The present selling price for dry phosphate, with an average mean analysis of 57 per cent tribasic or bone phosphate of lime is \$7 per ton of 2,240 lb. on wharf at Charleston.

As I have already said, the quantity of phosphate mined and sold in South Carolina during the past few years has been continually increasing until it has now reached the figure of about 500,000 tons per annum. Assuming that the unexploited deposits sti. cover an area of some thirty miles, and that they will yield the present average of 750 tons of phosphate to the acre, we may count upon a reserve of about 14,000,000 tons. With a constantly growing demand for "fertilizer" purposes, it would, therefore, seem as if the mining resources of the State would be exhausted in from fifteen to twenty years.

With a probable appreciation of these figures and facts, the efforts of the wealthiest mining companies now in the field are naturally directed toward the appropriation of all available and readily accessible deposits, and there is no doubt that while acquired on reasonable terms and worked with economy their exploitation will continue to be attended with very profitable results.

The dividends distributed during the past year by some of the companies, whose figures have been published, amounted to a trifle less than \$500,000, and it is significant of the rapid intellectual growth and commercial and industrial development of the South that of the total phosphate mined in the State, more than one-fifth is actually used in Charleston for manufacturing purposes. About one-third of the balance is exported to Great Britain and Germany, and the remainder is principally sent coastwise to Richmond, Baltimore, Philadelphia and New York.

When the great benefits accruing to South Carolina and its people from this industry are appreciated, it will not appear strange that active search for phosphate beds of similar value should have been stimulated in the adjoining States, and that the most intense, not to say mad, excitement has manifested itself since the discovery some two years ago of the Florida phosphate deposits.

Note.—The Florida phosphate beds will be fully treated in the following article. (To be continued.)

THE glaze upon enameled cards is made by pressure upon a polished plate or rollers. The composition is chalk, clay, and a little starch. Good work is not possible without elaborate accessories.

RECENTLY PATENTED INVENTIONS. Engineering.

SYSTEM OF STREET CAR PROPUL-SION.-Frederick G. Wheeler, Montclair, N. J. Combined with the engine cylinders is a water chamber and a system of circulating pipes, with condensers arranged in the front lower part of the engine and connected with the exhaust ports of the cylinders, an auxiliary condenser being arranged on a higher level, while a pump connects the lower condensers and the water chamber. The construction is such as to cause the water to circulate through a series of tubes back to the water chamber, while the water of condensation is led back to the water chamber, forming a complete circulating system. The invention is an improvement on a former patented invention of the same inventor in that class of motors in which the water is heated in a stationary boiler and supplied to a water chamber on

Railway Appliances.

GONDOLA CAR.—Ferdinand E. Canda. New York City. This invention provides for the use of one or more lateral rads on the exterior of each side of the car body, the ends of the rods being provided with screw threads and nuts, the anchorage of the rods being made in the ends of the side $\dot{b}_0 ards$ and through iron castings forming anchor blocks, made in such form as to be completely clamped and held in place by the side boards, thereby being rendered secure against being pulled out. This improved lateral support is wholly outside of the interior surface, and none of the available space of the car is occupied by the rods or fixtures.

Electrical.

BATTERY. - Jacob O. Brinkerhoff, Hackensack, and Milton E. Smith, Rutherford, N. J. Combined with a copper cylinder forming one of the electrodes is an exciting fluid formed of an antimonious chloride and in contact with the inner and outer urfaces of the cylinder. The inventors claim for this battery long life, high voltage, and no creeping or corroding. The exciting agent may be used in houid or solid form and applied to one or both electrodes, in the common jar battery the electrodes extending into the antimonious chloride, while in the porous cup batteries only one electrode is immersed.

Mechanical Appliances.

BARREL HOOPING MACHINE. - Max Rosenow, Peoria, Ill. This invention provides attachments for the ordinary iron hoop driving or trussing machine, whereby the machine can be readily adapted for the driving of wooden hoops on barrels, providing also suitable means whereby the chine or head hoops can be more effectually placed on the barrel without danger of crushing or breaking them.

WOODEN HOOP LOCKS. - The same inventor has patented a simple and effective machine

positive manner. Combined with a revolving cutter head is a hoop-clamping device arranged at right angles to the rotation of the cutter head, the device being pivotally supported and vertically adjustable in relation to the cutters. The hoops, after having one end cut into a lock, are held by their lock cut to the forked edges of gauges, which set their uncut ends to the proper position for cutting.

OIL CUP. - Thomas McEntee, Jersey City, N. J. This is a lubricating device especially adapted for oiling the crank pin of a marine or other engine, or any moving portion of machinery requiring a constant and reliable oil feed, and where the oil is difficult to apply by the use of the ordinary cup or can It has a needle valve for adjustment to give the required feed, and the cup is made of sufficient size to supply oil for twenty-four hours, or as long as may be desired, the quantity of oil in the cup being always indicated by a gauge tube.

PLUMB AND LEVEL - William J. Garner and Thomas Connaughton, Latourell Falls, Oregon. This invention covers a combination device having an extensible support that can be lengthened or shortened, combined with one or more spirit levels and a plumb line and bob, the level being supported by the stock and arranged transversely of and adjacent to the bob, while a suspension device is connected with the bob and extended upwardly, being secured at a point above the level. At one edge of the stock is a spirit level and at the opposite edge is a swinging gravity level.

WATCH MAKER'S ROLLER REMOVER. -Michael L. Sheehan. New York City. This is an imwatch balance wheel staffs or pivots, the invention providing a simple construction whereby rollers may be disengaged from the staffs or pivots of balance wheels in an expeditious and convenient manner, without disturbing the hair spring or injuring the pivots or ruby

MECHANICAL MOVEMENT. — Israel F. Good, Allentown, Pa. In a suitable frame is mounted a vertical shaft having at its upper end a gear wheel. above which is secured a post supported by radial bars, novel features, the device being designed to furnish a simple means for multiplying speed and transmitting power.

Agricultural

belts. The stalks are held in an upright position at | dividers, compasses, etc.

for cutting the locks in wooden hoops in a quick and the time they are cut, the machine also spreading the butt of the shock prior to its delivery from the har-

> POTATO DIGGER AND HARVESTER.-Clinton Lanker, St. Joseph, Mo. This invention con- earpiece, the branch tube being located between the sists of a plow having a double mould board and dis- whistle and the mouthpiece. charging on to an inclined elevator provided with raking arms traveling over the grated bottom of the elevator to carry the potatoes upward, a discharge spout being arranged transversely below the elevator. The machine gathers the potatoes, separates them from the soil and weeds, and delivers the cleaned potatoes to bags or other receptacles carried on the machine.

Miscellaneous.

BLEACHING. - Honore Korwin de Pawlowski, Paris, France. This invention provides an apparatus for the bleaching of vegetable and animal matter, and the washing and scouring of wool and other substances, either woven or yarn or fiber, with the avoidance of manipulation. Combined with a series of vats containing liquid, and connected with each other below the level of the liquid, are two vacuum receptacles, placed on a higher level than the vats and connected with them below the level of the liquid, to effect alternately an automatic displacement of the liquid in the

CANE JUICE FILTRATION. - Leon Boyer, New Orleans, La. This is an improved apparatus for treating cane juice by filtration, designed to make the juice so clean that the custom of using berg, Ohligs, Germany. Combined with the pivoted lime to neutralize the acid in the juice can be so blades is a spring-pressed pin protruding through one simplified as to require but little skill or knowledge to of the blades so as to impinge upon the other, whereby carry it out. The invention provides a primary strainer the two blades are pressed against each other autoproved device for removing and replacing the rollers of box or filter composed of a series of strainer drawers arranged in sets one below the other, the drawers in each set being of one mesh, but the several sets being of successively finer mesh in a downward direction.

SPRAVING DEVICE -William J. Ruff Quincy, Ill. This invention relates to a liquid cooling apparatus more especially designed for spraying beer and ale worts, and adapted to prevent clogging of the device by small particles of hops and other substances liable to pass with the worts to the spraying apparatus. A valve is adapted to pass into the spraying orifice, being a gear wheel meshing with the lower gear wheel and held on an adjustable valvestem, while a piston held avoiding the necessity of putting the hands or fingers connected to the post by a universal joint, with other on the valve stem is adapted to automatically actuate in the hives and the attendant danger of being stung by the latter to remove the valve from the orifice when clogged.

MEASURING AND DRAWING INSTRU-MENT,-Charles W. James, Philadelphia, Pa. Combined with a forked arm are two arms of unequal length pivoted between the members of the forked arm, CORN HARVESTER. — Thomas B. the longer arm being of a length equal to that of the Jones, Radnor, Ohio. Combined with a gathering forked arm, while a block is adjustably secured to one frame hinged to swing laterally, and having yielding of the arms. The instrument is simple and durable in means for holding it normally parallel with the rows of construction, and can be readily manipulated to obcorn, are upper and lower endless belts carried by the tain or measure inside or outside angles and obframe, and a stalk-cutting mechanism below the lower tain the miters of them, or it may be used for caliperbelts for cutting the stalks as they pass between the ing, or arranged as a depth and end marking gauge,

SPEAKING TUBE AND EARIPHONE. -Frederick Schluchtner, Brooklyn, N. Y. This invention provides a speaking tube having, in addition to the usual mouthpiece, a branch tube with an attached operating handle exterior to the tube, and is closed by a spring on the handle.

Goods Exhibitor. - Noah E. Otto, Johnstown, Pa. A strong, compact frame, easily taken apart, carries a series of vertical rollers adapted to receive rolls of fabric, there being also combined with the frame a rack adapted to hold brooms and similar shaped articles. The invention is designed to provide a neat, compact and efficient receptacle for nolding and exhibiting rolls of carpets, oilcloths and other bulky and heavy fabrics, so that they may be well displayed and easily handled.

SAVINGS RECEPTACLE. -- Charles O. Burne, New York City. This invention relates to boxes used by depositors for collecting their savings from time to time and afterward depositing them in the bank. It provides a safety receptacle in which the box has a slot for entry of the coin, and an opening and closing lid, combined with a lock controlling the lid, a catch mechanism controlling the lock, and two keys, one key being stationary for operating the catch controlling the lock, and the other a movable key to the lock itself, thereby affording increased security.

Scissors or Shears.—Julius Langenmatically without using any hand pressure during the blades cutting the material during the whole cutting movement, from the point where the edges meet toward the ends.

BEE HIVE TONGS. — Crawford D. Holt, Murray, Ky. This is a novel form of tongs for handling the comb frames of bee hives, the tongs having jaws adapted to clasp the tops and sides of the frames, with means for locking the jaws in position. These tongs afford ready means of handling the frames,

SASH FASTENER - Charles E. Angell, Salt Lake City, Utah. This is a combined window sash lock and lift, consisting of a positive locking bolt adapted to automatically engage with bolt holes in the window frame, an attached key for operating the bolt, a pivoted thumb piece applied to the outer end of the key to operate the key and serve as a lifter, together with an adjustable dog or catch adapted to engage with the key to prevent the latter from turning to act upon the locking bolt.

THILL COUPLING. - Augustus Beale, Brooklyn, N. Y. This invention provides a shaft

coupling designed to be simple, durable and noiseless. whereby the pole may be conveniently connected to or detached from the axle by the most inexperienced helper. It also provides a means whereby the safety straps may be readily connected with or disengaged from the pole or shaft.

LOAD BINDER. - Harry M. Bradley, Canon City, Col. A longitudinally slotted bar with teeth on opposite sides has an aperture in one end for the attachment of a rope, the bar being passed through a slot in a lever, where it is held by a pin and spring-pressed pawls, and there being a rope attached to the lever, the whole forming a simple and conve nient device for binding toads upon vehicles in a quick and secure manner. The device may also be used for pulling posts, tightening wire, and as a lifting jack.

WAGON BRAKE. - John W. Herrin, Mount Vernon, Ill. This invention provides a brake which will be automatically applied to the front wheels when the vehicle to which it is attached starts down on an inclined grade, and will be automatically released when a level grade is reached or the vehicle is started up hill. The invention also provides a locking device whereby the brake may be locked either when applied or released, thus taking all strain off the draught animals.

WATERING TROUGH.—John T. Thatcher, Frankfort, Ind. This trough has an apertured end, with a valve arranged to slide past the aperture, in combination with a float hinged to the side of the trough and a rod connected with the valve at its lower end and adjustably connected with the float at its apper end. It is designed that the trough shall always be filled to a definite level, the valve and float working to effect this automatically.

STOVE. — James W. Calta, Castalia, South Dakota. This is a stove of simple and durable construction for heating and cooking purposes, and specially designed for burning hay, straw, trash and rubbish as fuel. All the heat generated is passed around four sides of au oven, and the draught is readily so arranged as to entirely avoid the puffing of the

OIL CAN AND LAMP FILLER.—Charles W. Proctor, Lake Forest, Ill. This is a portable device, secured on a post having a suitable base, the can having a valved outlet at its lower end connected with a delivery tube through which oil is supplied to a lamp without any waste and without the use of pumps. The device is simple and durable, and the oil flows by gravity from the can to the lamp.

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SCIENTIFIC AMERICAN

BUILDING EDITION.

JUNE NUMBER.-(No. 68.)

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(3113) G. M. says: A question has come up as to whether a piece of 11ron dropped into water of any given depth would sink to the bottomor would find a point where its density and that of the water would be the same, and cousequently remain suspended. Will you kindly answer this and give explanation, also please state the greatest depth of any well or boring in the world? A. The iron will sink to the bottom of the deepest oceans. Every solid substance that is heavier than water sinks to the bottom. The bottoms of the deep oceans are covered with gravel, sand and mud, with shells and vegetable growth of the deep seas. Fish and other living organisms are found at great depths. The pressure of the water is in proportion to the depth, but its density is but very slighty increased, as water can be but very slightly compressed under grea pressures. The deepest bored well is about 5,000 feet.

(3114) A. C. R. asks: 1. Is lead a good electrical conductor? A. It has twelve times the resistance of copper. 2. Can you give me a recipe for a good cheap silver polish? A. Use whiting and alcohol. 3. Have the effects of a kaleidoscope ever been shown on the wall like a magic lantern? If so, is the apparatus difficult to make ? A. The kaleidoscope car be thus used. It is described in Dolbear's "Art of Projection," \$2 by mail.

(3115) M. T. F. asks for the cheapest way of making hydrogen gas. I wish to use it for a balloon in small towns where I can't find the manufactured gas A. By treatment of iron or zinc scrap with dilute sul phuric acid. This is the usual way on a small scale, On the larger scale it may be made by passing steam ver red hot iron scrap.

(3116) J. S. R. asks (1) as to the obelisk (in Central Park, New York), and also the Pyramids of Egypt. Are they not generally considered (by scientifimen) a composition, and not blocks of natural stone A. They are natural stone, not an artificial composition. 2. What was the date of publication of the first number of Scientific American? Was it a monthly paper, or or magazine, in its youth? A. September, 1845. It was a weekly.

(3117) W. F. B. asks how bird lime is made; it is used to trap birds. A. One receipt is to boi linseed oil until thick and viscid. There is much dange of conflagration in conducting this operation. A bet ter way is to boil the middle bark of the holly for seve or eight hours in water, and put in a heap in a hole in the earth covered with boards or stones for some weeks until reduced to a mucilaginous mass. It must b rubbed up in a mortar and washed until clean, and pu into earthen pots.

(3118) P. B. says A and B have an argumentahout the motion of a clock's pendulum. A say it never stops in its forward and backward motion. I says it does, or it could not reverse. Who is right? A

before it can change or reverse its movement. The time required for the change is very short and not within our perception to measure it.

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AND EACH BEARING THAT DATE.

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1	Car for underground electric systems, motor, J. J. Miller	454,178	Į:
	J. Miller. Car, railway, W. C. Whitner. Cars, safety guard for sleeping, N. Brown. Cag, sand box for, H. F. Parker. Cars, steam heating system for railway, J. F. McElrov.	454,178 454,099 454,202 454,182	I I
0	Cars, steam heating system for railway, J. F. McElroy	454.286	J J
e	Card holder, G. K. Kelsea. Card list J. H. Fezandie. Carding machine, bair, F. J. Mauborgne.	454,286 454,277 454,265 454,175	J
r	Carding machine, hair, F. J. Mauborgne Carrier. See Cartridge carrier.		K
9	Cart, road, M. Halipenny Cart, road, L. M. Smith	454,347 454,157 454,333	E
1	Carrier. See Cartridge carrier. Cart, road, M. Haffpenny. Cart, road, L. M. Smith. Castridge carrier, L. M. R. Daudeteau. Case. See Pocket case. Cash recorder, W. H. Thompson. Caster, furniture, H. McDonald. Caster, socket, Crean & Stone. Cattle rack, J. H. Howard. Caustic sikeli etc. manufacture of A. Kayser.	454,089	İ
е	Caster, furniture, H. McDonald	454,284 454,257	Î
r	Cattle rack, J. H. Howard. Caustic alkali, etc., manufacture of, A. Kayser Centrifugal machine, T. Long.	454,357 454,136	ī
t	Centrifugal machine, T. Long. Centrifugal separator, H. Stauton	454,056 454,408	I
1	Chain link, drive, T. Maxon	454,176	Î
e	Caustic alkali, etc., manufacture of, A. Kayser Centrifugal machine, T. Long. Centrifugal separator, H. Stauton Centrifugal separator, H. Stauton Centrifugal vessels, balancing, P. M. Sharples. Chair link, drive, T. Maxon. Chair, J. G. Wilson. Chair and sewing machine top, combined, M. M. Bostick. Check book, W. F. Knowles. Chuck, drill, J. N. Skinner. Cigar bundling machine, Albert & Rathkamp. Cigarmaker's implement. T. Streat. Clock striking mechanism, G. W. Shuman. Closet. See Knockdown closet. Clutch, friction, C. Hermann.	454,100	Ī
r	Bostick. Check book, W. F. Knowles.	. 454,251 . 454,361	İ
n	Cigar bundling machine, Albert & Rathkamp	454,246 454,084	Î
e	Clock striking mechanism, G. W. Shuman	454,299	I
f	Clutch, friction, C. Hermann Clutch mechanism, J. A. Dyblie Clutching and releasing mechanism, E. C. McFar	454,435 454,261	Î
	Cutching and releasing mechanism, E. C. McFar- land Coal separator and cleaner, Smith & Bishop Cock, gas, Stafford & Hudson.	454,141	I
7	Cock, gas, Stafford & Hudson	454,234	1 T
n 3.	Coffin cover, I. G. Kregel. Collar or cuff protector, E. J. B. Bowyer.	454,363 454,201	İ
-	Cofferdam J. E. Robinson. Coffin cover, L. G. Kregel Collar or cuff protector, E. J. B. Bowyer. Comb. See Curry comb. Commode, D. H. Kurphy	454,128	Į
n	Goldthwaite	454,402	I
•	Confectionery, machine for making, P. Knorpp Convertible chair. L. Jorgensen	454,278 454,276	N
ζ	Corsets, L. Harmon Corsets, etc., clasp for, H. F. Wyatt	454,167 454,104	Ď
f	S. Thomas et al	454,146	N
?	Coupling. See Car coupling. Hose coupling Pipe coupling. Thill coupling. Cradle, H. Weber. Crank pin, G. W. Rogers. Cultivator, W. C. De Graffenried. Current collecting device, R. M. Hunter. Curry comb. E. C. Hempel. Cutter. See Glass tube cutter. Cycle saddle, W. A. Hance. Dental engine, W. W. Williamson. Dentures, apparatus for making, R. E. Zellers. Desk and document cabinet, combination, C. E. Lucas.	454 101	1
1.	Crank pin, G. W. Rogers	454,229 454,036	1
r	Current collecting device, R. M. Hunter Curry comb, E. C. Hempel	454,437 454,269	1 1
8	Cutter. See Glass tube cutter. Cycle saddle, W. A. Hance.	454,431	I
	Dentures, apparatus for making, R. E. Zellers Dentures, vulcanizing rubber. G. R. Snow	454,415	I
8 il	Desk and document cabinet, combination, C. E.	454,368	1
F	Dies, taps, etc., machine for cutting, A. W. Cash. Display rack or case, S. B. Calkins	. 454,029 . 454,164	8
t· n	Distilling apparatus, T. McGowan	. 454,061 . 454,360	
n	Door matger, L. Terry Door mat, metal, E. R. Landon. Door spring, W. C. Smith	. 454,439 . 454,439	I
3, e	Draught equalizer, W. Z. Runkle	. 454,069 . 454,101	Í
ıt	Drier. See Boot drier.		İ
	Dring line support, J. Pagliughl et al	. 454,377 . 454,165	1
۱-	Egg beater, D. A. Wilkinson	. 454,194 . 454,194 . 454 900	i
B	Elastic washer, C. E. Swan	454,085	li
١.	Electric conduit, tubular, E. H. Johnson	. 454,313 . 454,275	ļ
u	· moderic current indicator, A. B. Herrick	(ا) تشويع	

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