The Model B Brush Runabout

The Brush Runabout Company of Detroit, Mich., offer a light car of low cost equipped with a single cylinder vertical engine and two speed and reverse planetary change gear. This car is somewhat similar to the first Brush car, but for 1909, many refinements in design and materials are employed. An instance of this refinement is found in the engine proper. Here the power at rated speed has been increased from about 6 b. h. p. to a fraction over 7 b. h. p., without altering cylinder dimensions, valve sizes, port dimensions, etc., due simply to refinements in carburetion, ignition and valve timing.

The car chassis, 74-inch wheel base and either 56 or 60-inch tread, as desired, fitted with two seat body and rear carrying space sells for $500 with 32 by 2-inch solid tires and for $550 with 28 by 3-inch pneumatics. The company furnishes extra sets of wheels together with tires, sprockets (front and rear), and chains for $160 and $110 for pneumatic and solids respectively. The reason advanced for furnishing these extra wheel and driving sets is that, when one has both, a quick change can be made from one to the other and thus the car be made to give the maximum of satisfaction under all road and speed conditions. In general, the company advises pneumatics for use over poor city pavements and for average speeds of over 15 miles per hour, and solid tires when the average running speed is lower, the roads soft or deep with mud.

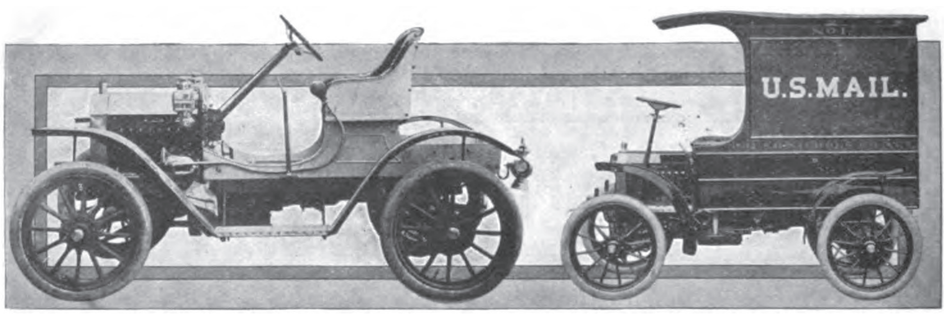

Fig. 1. Views of the Brush Single Cylinder Runabout and Light Delivery Wagon. both using the same chassis. This car has a single cylinder. four-inch bore and stroke, seven H. P. motor. specially balanced to make it vibrationless, and the car is mounted on four vertical helical springs and shock-absorbing arms. Price $500 with 32 x 2-inch solid tires. or $550 with 28 x 3-inch pneumatic tires.

BUILT TO USE SOLID TIRES.

While pneumatics are regularly fitted, as above, the car has been designed thruout with the use of solid tires in view. The working out of the design along this line is seen in almost every feature of the chassis: wooden frame sills and end members, helical spring suspension with shock absorbing radius rods, large section steering knuckles and axle ends, low gearing ratios, and last, and most distinctive, the employment of large diameter, round section wooden axles. With solid tires, the chief difficulties heretofore encountered have been fatigue and breakage of axle parts and in fact all running gear parts between the springs and the road surface. These destructive effects of vibration from solid tires have been in this car minimized and eliminated by a reduction in car weight and speed (30 miles per hour maximum with pneumatics and high gearing ratio) and a substitution of wood, which is less subject to fatigue and entirely free from crystalization, for axle material. Upon the ends of the wooden axles are fitted high grade steel parts forming the steering yokes, ball and socket spring seats, and the rear wheel journals and brake supporting and operating mechanism. The total car weight, without passengers, is with full equipment between 900 and 1,000 lbs. Each axle, before the application of the steel truss rods, is subjected to a load equal to the car weight applied at its central point, it being supported at its extreme ends. Since only approximately one-half of this load can ever be applied to the axle in service, and since in service the points of application of this load are near the extreme ends of the axles (see location of spring seats in chassis plan) it is very apparent that the factor of safety in these axles is unusually high. The makers claim a safety factor for these parts of between 20 and 24. The four frame members and both axles are made of either oak, maple or hickory and are all impregnated with oil to make them weather proof even after the paint becomes worn off or chipped.

All frame corner brackets are mortised in and bolted in three directions. Each end of the two cross frame members has bolted to it a bracket which carries the lower end of a heavy, helical spring of rectangular cross section. As shown in the spring section herewith, the top of the coil is closed and rigidly attached to the top of a steel rod provided with an integral ball of large diameter on its lower end. The ball seats universally in a spherical socket and is nut retained and enclosed with lubricant in a leather casing, not shown. Each helical spring is

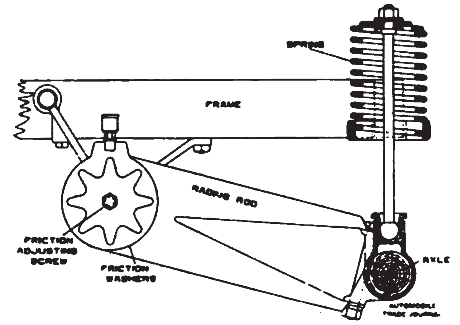

Fig. 2. Detail view of the peculiar Brush Runabout, helical spring and shock absorbing radius rod. This view also shows a section of one of the solid wooden axles.

tested to an elongation of twice that possible after assemblage and any showing permanent set under these conditions are rejected. Due to the spring action elongating or stretching the spring, as shown, it is impossible for the springs to be affected by rebound, since, in such case, they simply close to their limit and that is all there is to it.

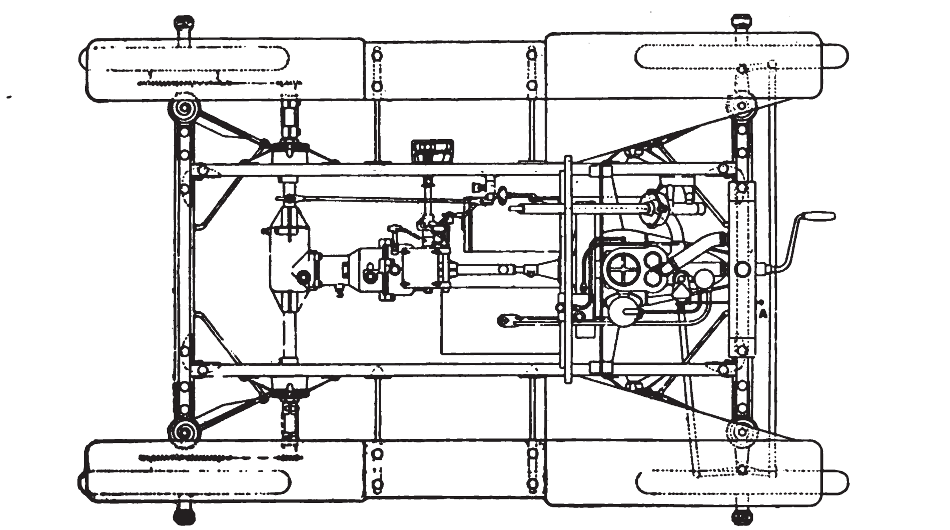

Fig. 3. Plan of the Brush Runabout chassis, showing the location of the engine in a vertical position under the hood at the front, also the arrangement of the special planetary change speed gear case operated by side lever, and also the jack shaft with side chains to the rear wheels. The wheel base is 74 inches, with either 56 or 60-inch tread, as desired. The frame as well as the axles are wood. The car is geared for about twenty miles an hour at 1500 revolutions of the engine, if fitted with solid tires, and about 25 miles an hour at the same engine speed when supplied with pneumatics, solid tires being recommended by the makers when the average running speed is less than 15 miles an hour and over soft or muddy roads.

SHOCK ABSORBING DEVICE.

Probably as interesting a feature as there is on the car is shown in this same cut. Reference is here had to the radius rods, which construction will be clearly understood by co-reference to the chassis plan. Supported by brackets riveted to the frame side members are two stationary discs or plates between which work the disc shaped forward ends of the pressed steel radius rods. Star shaped pieces of spring steel together with through bolts provide an adjustment of the amount of friction set up between these discs, the friction surfaces of which are lubricated from grease cups as shown. This method of supporting the forward ends of the radius rods incorporates a shock absorbing device at each corner of the frame and serves to steady the car over rough roads and at the same time makes possible the employment of the extremely flexible and sensitive helical springs. This combination of very lively spring suspension with adjustable dampeners is a long step in the solution of the solid-tire-easy-riding problem. The method of diagonal trussing of the radius rods to the axles to prevent side swipe is well shown in the chassis plan. Each wheel is carried on two ball races, the inner being of 3 inches diameter with ⅝-inch balls and the outer bearings of 2 inches diameter with ⅜-inch balls.

Brass bound running boards are carried upon forged step irons bolted to the side members and further trussed by under-running rods extending across the car. Flanged fenders are mounted on forged rods bolted to the frame cross members and to the ends of the running boards. The bodies are free and unencumbered and carry no parts of the mechanism—even the gasoline tank being suspended from the frame.

THE ENGINE.

Many distinctive and ingenious features are found in the engine. This is of the single cylinder vertical type mounted in front under a hood. The cylinder is of 4-inch bore and stroke with inlet and exhaust valves side by side in a single combustion chamber pocket and operated from the same cam shaft through individual cams and roller ended cam followers. The cylinder walls and jacket walls are integral as in average practice, but the cylinder head is removable and screws into the cylinder, seating gastight upon a tapered seat. This construction makes the working parts very accessible, since

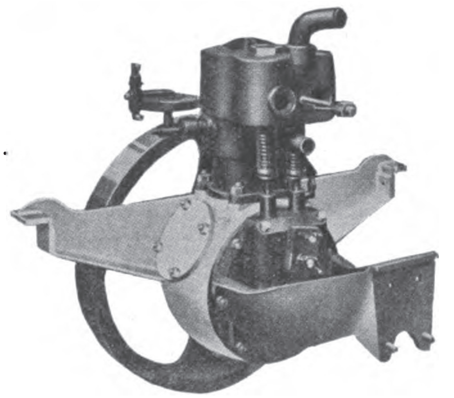

Fig. 4. Brush 7 H. P., 4-inch bore and 4-inch stroke engine, showing three-point suspension supporting arms, water connections valves, cam chamber, crank case hand hole, peculiar pulsation gasoline pump on the front and the very large flywheel.

all that is necessary when it is desired to remove the piston and connecting rods from the engine, is the removal of the cylinder head and a disconnection of the connecting rod big end from the crank pin. With the cylinder head removed, the entire combustion chamber wall surface can be seen and all carbon deposits readily removed. Screw plugs permit of the ready removal of both valves. Cooling water circulates thermo-syphonically thru the jacket, entering just below the valve chamber and leaving at the top between the two valves, and a large capacity cellular radiator of small size mounted in front.

An aluminum crank case, having two heavy L section integral arms for attachment to the frame side members, is employed. This case is of the so-called barrel type, the main crank journal boxes being formed in end plates, the forward of which bolts up to the case casting. These boxes are bushed with nickel babbit, and because of this construction and the ample sizes of the bearing surfaces (3 3-16 inches by 1¼ inches for the front bearing and 3 3-16 by 1⅜ inches for the rear or flywheel bearing) extremely long life together with a maximum of accessibility is had. The front journal plate, of cast iron, has bolted up with it a very rigid supporting arm which rests upon and is bolted to the front frame cross member, completing the triangular or three point motor suspension. This front journal plate also carries the cams and cam shaft in a chamber separate from the crank case, but which communicates with the latter and secures its supply of oil therefrom. In the photographic elevation of the engine herewith, is shown the motor suspension and general appearance of the engine, minus the carburetor and exhaust pipe. It is worthy of note that the starting crank is carried in a flanged bearing box which bolts to the forward end of the front suspension arm by means of the two studs shown. In this way the starting crank is made a part of the engine unit and its perfect alignment with the crank shaft is insured at all times.

CRANK SHAFT DETAILS.

In the line section through the crank case it will be noted that some points in the design are as original as they are meritorious. The large external flywheel on the rear, driving end of the shaft is drawn up on a tapered portion and retained by keys and nut. The crank shaft is a drop forging and is machined to size all over. The butts of the crank webs are milled square and have fitted to them a novel form of counterweight. The counterweights are steel castings, strongly webbed and retained by studs and castellated nuts as shown. The outer parts of these weights are cast hollow and are filled with lead, which material lends itself to easy working by the assemblers when the reciprocating and rotating parts are finally balanced with reference to each other.

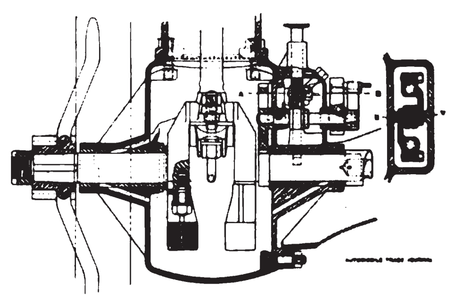

Fig. 5. Cross-section of the Brush single-cylinder engine crank case, showing counter weights filled with lead, the return oil ways from the main bearings into the case, the cam gears and the small double cam shaft in its case above the main shaft. At the right is shown a horizontal section on the line A. B. through the cam-follower rollers, as described in the text.

For light runabouts of low power and medium speed there can be no engine type so cheap to operate and maintain as a single cylinder. This is a fact which is well known generally. It makes for simplicity, low first cost, ease of adjustment, requires a minimum of care, can be made of maximum accessibility, etc., almost without end. But there is one point inherent in its type which has caused it to lose favor—proneness to excessive vibration unless most carefully and accurately balanced. However, a single cylinder engine can be balanced to the elimination of injurious and unpleasant vibration if careful and intelligent application of counterweights is made. This has been done in the engine under discussion and will be reverted to in that part of this description which deals with the road performance of the car.

All crank shaft journals are ground to size and run in boxes which are scraped to an accurate running fit. Each bearing is provided with large oil ducts thru which oil enters the bearings from the crank case splash, and also with passages providfor the return of oil to the case after it has performed its function in the journals. The bearing boxes are fitted with special circular grooves which prevent the throwing of oil from the case at the points where the crank shaft extends through. The end thrust of the crank shaft, none of which is due to the drive but simply that due to the weight of the shaft itself when the car stands in an inclined position, as when ascending or descending a grade, is taken upon two steel thrust washers as shown. To the external forward end of the crank shaft is pinned a single tooth face ratchet for engagement with a pin set into the inner end of the starting crank spindle.

THE CHANGE GEAR.

Set into the flywheel hub and parallel with the crank shaft are four studs of high grade steel over which fits a steel member keyed and clamped upon the forward end of the driving or primary change gear shaft. In the sectional view of the change gear, these parts are shown clearly. The driven shaft is free in an endwise direction, with reference to the engine, and can thus communicate no thrust to the engine crank shaft.

The change gear provides two forward speeds and one reverse and is of the internal spur gear type. The action of this gear is the same as that of other change gears of this type in so far as the functions of the gears themselves are concerned; but the methods of securing the several speeds, or rather means for the detention of the members which give these speeds, are original. Referring to Fig. 6, it is seen that clutches of the disc variety take the places of the conventional brake bands acting upon drum surfaces.

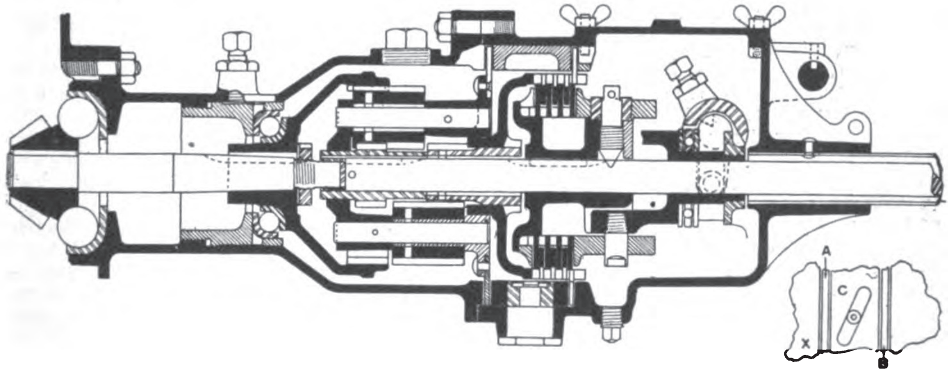

Fig. 6. Sectional view of the Brush enclosed planetary change gear. This change gear forms a unit with the jack shaft illustrated in Fig. 8, and is suspended from the side frame members by the jack shaft brackets and in front at a single point, thus giving a three-point suspension. Plain and ball bearings are used, and instead of fans acting on drums friction rings, as described in the text, are employed giving exceptionally smooth action.

In the Brush change gear, it is sought to assist the maintenance of gear quietness and efficiency through so designing the detention members that the bearings shall be relieved of all unnecessary work. To this end, there are two bronze discs riveted to the low speed and reverse elements, which in most planetaries consist of drums with brake bands, indicated as A and B in the sketch at the right of Fig. 6. Between the discs A and B is placed a ring with finished ends and which fits freely in a bore in the housing. The two members of the housing also have finished ring surfaces which present themselves to the outer surfaces of these bronze rings. The ring, marked C in the drawing, has bolted to it a lever which extends through a slot in the wall of the housing and is connected to the control mechanism by linkage in such a way that it may be made to rotate in either direction within its bore in the housing, depending upon the direction of the motion imparted to the control lever at the side of the car. As shown, there are two short helical slots cut in the cylindrical surface of the ring C. Into these slots fit two rollers carried on spindles which are integral with screw plugs inserted in the sides of the case.

The action upon engagement is now obvious. The bronze discs, A and B, revolve in opposite directions when the engine is running idle, as indicated by the arrows in the detail sketch. If now the ring C is rotated by its linkage in a downward direction, the same as that of the disc A, it will move toward the left at the same time and, as the motion is continued, will engage the disc A and finally force it into engagement with the stationary surface X of the housing. If it is rotated in the opposite direction, disc B will be engaged and finally held stationary. In operation of the car, it is usual to fully engage these clutches at once by means of the side lever; but since the case is filled with oil and the rotation of the bronze discs fills the spaces between the engaging surfaces with oil, due to centrifugal action upon the oil, the engagement is not nor cannot be made harsh. When the lever is thrown to its extreme low speed position,

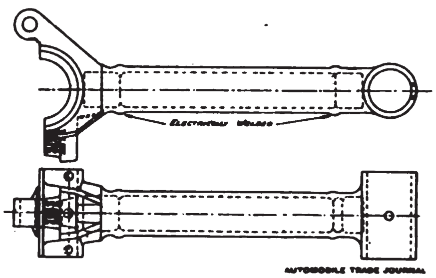

Fig. 7. Views of the electrically welded connecting rod of the Brush Runabout. This rod is fitted with a hinged cap at the lower end and is made of three forgings electrically welded into a unit. The big end bearing is fitted with swedged babbitt.

there is no sharp engagement felt, but in its stead the car starts softly and gradually but firmly accelerates as the oil is squeezed out by the wedging action of the disc and floating ring until the disc is held stationary, when the engine drives positively. It is probably needless to say that the heavier the load the stronger and more positive will be the engagement and that these parts need no adjustment for wear.

The high speed clutch which binds the whole gear into a single freely rotating unit is of the multiple disc type, employing four driving discs of hardened steel and three driven discs of phosphor bronze. The sliding carrier of the driving discs is also helically slotted and the same rotating-end-motion-wedging action is here utilized to secure gradual engagement with the same heavy load characteristics as those mentioned for the low and reverse clutch action. The high speed clutch is

the employment of some such clutch design as above described: the interlocking linkage between the brake pedal and the high gear controlling mechanism so that when it is desired to stop the car, momentarily slow down or disengage the engine, one need not handle the side lever at all, but simply presses upon the brake pedal to secure the above actions. If a slow down under the brake or a disengagement of the engine is desired, as in traffic, the clutch takes hold again automatically upon the release of the pedal, just as in a car with sliding change gear. This is a very valuable feature and adds much to the comfort of the operator, as all know who have handled cars with sliding gears and have afterward been called upon to operate the conventional planetary. Another considerable advantage found in this change gear is that all speeds lock themselves in engagement automatically and it is therefore unnecessary to maintain a continued pressure with hand or foot, as when ascending grades.

DISTINCTIVE CONNECTING ROD.

Recognizing the importance, referred to engine balance, of employing reciprocating parts of the least possible weight consistent with sufficient strength, an extremely light connecting rod is here used. The rod proper consists of two steel drop forgings and a section of seamless steel tubing, the three parts being electrically welded at the points shown in the drawing herewith. This construction is not the cheapest that could be used, but it has given absolute satisfaction from all viewpoints and failures are unknown. The lower or big end is hinged for simplicity in adjusting and assembling, is lined with nickle babbit and provides a bearing 2 inches by 1⅜ inches. The upper end is non-adjustable bronze bushed and provides a bearing 2 by 25-32 inches. The lower end of the rod is reached for adjustment through the large hand hole shown in the elevation of the engine.

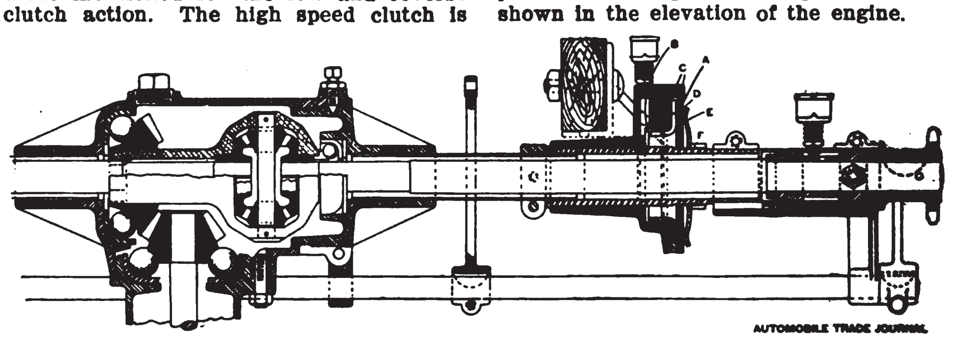

Fig. 8. Brush Runabout jack shaft and differential assembly, showing large ball bearings and their adjustment, semi-floating sprocket shafts, and the details of the rear shock-absorbing radius rod attachment to the frame.

operated in the same way as the other two, i. e., placed fully in by the side lever, easy engagement and gentle but positive acceleration of the car being attained automatically. There is one feature of the change gear control found in these cars which is possible of simple attainment only through

VALVE MECHANISM.

The cams and cam followers are housed in a chamber integral with the forward crank journal plate, as before mentioned. The timing pinion is integral with the crank shaft and meshes with a cast iron gear wheel which is keyed, pressed and riveted to the end of the cam shaft. One peculiar feature of these parts of the engine is that no bushings are provided for either the cam shaft or the cam followers. These parts are hardened and bear directly upon the metal (cast iron) of the forward journal plate. Such combinations for authomobile journals are rare, but the fact remains that hardened steel shafts running in cast iron boxes have been employed for many years in other services and that several automobile builders are only now becoming aware of the manufacturing and long life advantages to be had through their use.

The cam follower construction is very interesting. These, instead of being yoke ended as in average practice, are straight rods with integral disc heads, which contact the lower ends of the valve stems, threaded in the center and provided with bearing surfaces at each end. This is all clearly shown in the crank case section. Upon the threaded portions are screwed and clamped forged pieces which carry at their outer ends the follower rollers and their studs. The front of the cam chamber has a removable cover held in place by dowels and two long diagonally placed bolts as shown. Upon removal of this cover, the entire mechanism is exposed. Reference to the crank case section and to the section through the mechanism on the line A-B, there indicated, makes clear the manner of assembling and the extreme ease of adjustment, removal or replacement of these parts. It will be noted that the crank case end plate and the cam chamber cover have milled upon their inner faces the flats X and Y. The threaded cam follower stems are free to turn in their bearings, and in assembling are introduced from above and screwed into the forged roller carriers which are introduced through the opening left by the removal of the cover plate. The roller studs are riveted into the forged pieces and the rollers simply slipped into place after the other parts are in position. Each of the roller carriers has a flat which bears against one or other of the flats X, Y and when the parts are all in place the clamping screws tightened, and the cover on, it is impossible for the followers to turn. Clearance between the followers and valve stems is adjusted by loosening the clamp screws and turning the follower stems either up or down until the clearance is right. Long life for the follower bearings is secured through their ample size and the fact that the bearing is on each side of the cam and thus avoids cramping and uneven wear. The two cams are made in one piece and secured to the shaft by a large tapered pin.

ENGINE ACCESSORIES.

Charge ignition is had from a high tension coil mounted on the dash. The circuit breaker or timer is of the wipe contact type and is mounted on the forward end of the cam shaft and fully enclosed.

GASOLINE PUMPED TO ENGINE.

A cylindrical oil tank is mounted on the dash and feeds to the engine crank case through a sight feed oil being lifted and forced through by exhaust gas pressure which is proportional to the engine load and therefore never feeds more than is needed.

The fuel system remains the same as used formerly, but because of its originality and simplicity will be again briefly described: Under the right floor boards of the car is suspended a cylindrical gasoline tank from which there are two pipe leads. One of these extends to the bottom of the tank and communicates with the intake check valve of a diaphragm pump. The pump consists of a simple diaphragm mounted centrally within a circular chamber of small depth. One side of the diaphragm is acted upon by cylinder gas pressure through a small passage communicating with the cylinder bore and uncovered by the piston toward the end of its stroke; and the chamber on the other side connects, through the above mentioned valve and pipe, with the fuel tank. As the piston travels up and down in the cylinder it periodically uncovers the port communicating with the lower diaphragm chamber and thus causes the diaphragm to pulsate and therefore pump fuel from the tank. After entering the pump, the fuel leaves through a second check valve and is forced into a constant level chamber, of the over flow type, from which all surplus fuel drains back into the tank through the second pipe lead mentioned above. This constant level chamber takes the place in the carbureting system of the usual float chamber. The constant level chamber, conventional mixing device and throttle valve are located slightly above the cylinder valve port and to the front of the engine where they are out of the way of all parts which it might be desirable to reach for adjustment or inspection.

The carburetor and exhaust pipe are retained in place on the motor by a single stud and yoke, and the muffler is located under the floor boards on the side of the car opposite the fuel tank. The whole engine lay out has been made with a view to great accessibility, ease of inspection, reliability and simplicity.

All gear, sleeve and spindle bearings are of bronze and are automatically lubricated by the oil contained in the case.

The rear transmission member of the change gear is made up of a shaft, bevel driving pinion and a large internal gear, keyed, riveted and pinned to form a unit. This secondary shaft is reduced in diameter at its forward end and enters a bushing carried by the rear end of the primary shaft. The secondary shaft is carried in two ball sets, 4 inches in diameter with 1 inch balls at the bevel pinnion and 3¼ inches in diameter with ½ inch balls at the forward end. A threaded bushing held in adjustment by a lock-nutted set screw serves to adjust these two balls races.

DRIVING AND DIFFERENTIAL GEARS.

The bevel driving pinion and gear have 15 and 24 teeth, respectively, giving a driving ratio of 1.6:1. The differential yoke and driving gear members are carried on ball bearings—⅞ inch balls behind the gear and ½ inch balls behind the differential as shown in Fig. 8. The differential gearing comprises two bevel gears and two bevel pinions mounted on a single spindle and carried by a one-piece yoke.

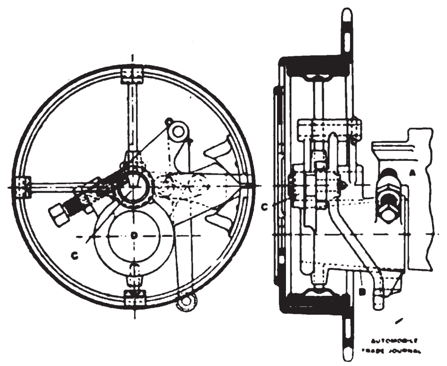

Fig. 9. Brush rear axle end, brake drum and sprocket chain adjuster, brake shoe and bearing mechanism.

shaped carrier to which the driving gear X is attached. The driving jack shafts enter square holes in the bosses of the differential bevel gears and are carried at their outer ends in bronze bushings 3 by 1 inches. Lubrication at these points is by compression grease cups. Inserted into bosses in the ends of the differential housing are steel enclosing tubes which extend to points just beneath the frame side members. These enclosing tubes fit into other steel tubes which are carried in brackets on the sides of the frame and have formed upon them the threads, keyways, etc., which serve to retain all these parts in position.

This figure also shows the construction adopted for the attachment of the pressed steel shock absorber radius rods for the rear axle. Here A is the forward disc end of the pressed steel radius rod pressed into the shape shown to provide a bearing against the bushing B upon which the chain and brake loads may be taken. C, C are fibre friction discs clamping between them the radius rod end and finding their stationary bearing surfaces against the bracket member, which carries the grease cup for lubricating the friction surfaces, and the stationary disc D, the tension of the star shaped spring E, set up by the nut F, providing the necessary frictional drag between these surfaces.

GEARING RATIOS.

The jack shafts can be withdrawn from the enclosing tubes upon the removal of the set screws which hold the outboard bronze bushings in place. The driving sprockets, which may be had with either 13 or 16 teeth, are retained by Woodruff keys and pins, and are very readily removed and replaced when it is desired to change the gearing ratio.

From these sprockets the drive is by roller chain to driven sprockets mounted on the rear wheels of either 42, 50 or 58 teeth. The standard gearing with solid tired wheels of 32 inches diameter is the 13 and 50 tooth sprockets, which gives a speed of 19½ miles per hour at an engine speed of 1,500 revolutions per minute. With 28 inch pneumatic tires the standard gearing is either the 16 and 50 tooth sprockets or the 13 and 42 tooth sprockets, either of which gives a car speed of about 25 miles per hour at the above engine speed. For either solid or pneumatic tires, either higher or lower gearing ratios can be had as desired by using different sprocket combinations. However, unless otherwise specified, the above standard gearing ratios will be delivered.

BRAKE AND REAR HUB CONSTRUCTION.

As stated in the foregoing, the metallic steering yokes and rear wheel bearing spindles together with the brake mechanism are clamped and bolted upon the ends of the wooden axles. The underrunning truss rods are in each case attached to these end fittings and therefore materially assist in binding each into a unit. In both the front and rear, the axle is somewhat lower than the wheel spindle. This eccentricity is utilized in the case of the rear axle to provide a ready means for chain adjustment. The piece A, Fig. 9, is clamped rigidly to the axle end and has the hemi-spherical spring seat formed integrally with it. Over the conical portion of A fits another piece B which has three radial bosses formed upon its hub, the lower boss being the truss rod anchorage and the two upper ones carrying long, lock-nutted set screws, the ends of which engage between them a lug cast with the

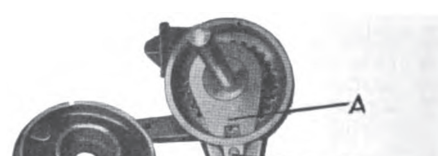

Fig. 10. Brush steering gear made irreversible by an eccentric motion, and consists of a spur and an internal gear.

piece A, as shown in the end view. Because of the eccentricity of the wheel spindle with reference to the center line of the axle proper, wheel center being C and axle center D, it appears that when it is desired to tighten the driving chain, all that is necessary is that the screw to the rear of the lug on A be slackened off while that engaging the forward side of the lug be tightened, each being again securely locked by means of the nuts provided. The piece B supports the brake mechanism and has inserted within it at C the rear wheel spindles.

Retained upon the hubs of the wheels by through bolts in the usual manner, are the integral brake drums and driving sprockets. The brake shoes are formed of heavy spring steel and faced with brake belting. Pressed steel pieces are carried on studs by the piece B to serve as guides for the brake shoes, which are expanded into engagement by the lever operated wedge and link, and which return to the disengaged position upon withdrawal of the wedge by virtue of their spring action, in which position they are supported free of the drums at four points. Links lead forward from the lower ends of the brake levers to the ends of levers carried on the ends of a long brake operating spindle which is mounted as shown in the section of the differential and jackshaft Fig. 8.

STEERING GEAR AND CONTROL MECHANISM.

The switch in the primary ignition circuit is incorporated with the coil on the dash. In the chassis plan is shown a so-called priming rod, which serves to hold the air valve closed when starting. The crank is automatically held in an upright position when disengaged from the shaft. The steering gear is extremely original and embodies irreversibility with quick action, a three-quarter turn of the hand wheel being all that is required to throw the wheels hard over in either direction, starting from the straight ahead position. Fig. 10 shows the gear with cover plate removed. Upon the lower end of the shaft, to which the steering hand wheel is attached, is formed an eccentric which has a bearing in the center of a boss formed with a simple spur gear on its under side, and a lever on its upper side. This lever A is slotted, as shown, and engages a square block which is pivoted on the pin B. This pin and sliding block engagement with the lever prevents the spur from turning and causes it to oscillate about the pin when the eccentric is shifted by a turning of the hand wheel. Below the lever portion of the spur gear and in mesh with it is an internal gear carried on a spindle which extends through the bottom of the case and has keyed and clamped upon it the steering lever shown. This lever connects by a link across the car with a lever on the steering stub axle of the right forward wheel. Due to the position in which the eccentric sets when the car wheels are in the straight ahead position, and to the constantly changing length of the oscillating lever as the eccentric is turned, the motion imparted to the road wheels is at first slow and then faster, for equal angular displacement of the hand wheel. The eccentric makes this gear reversible.

THE CONTROL.

In these cars the driver's seat is on the left side. The steering post is inclined and enclosed in a brass tube, which carries at its upper end, and just below the hand wheel, the throttle and spark advance levers, set on opposite sides, which are fitted with knob ends for ready handling.

The change gear lever at the side of the car controls the speed changes and the emergency brake selectively. No gate is fitted, the lever oscillating in a single slotted quadrant and when drawn sidewise serving to shift its spindle longitudinally. With the lever drawn toward the operator, the reverse is had by a forward motion and the low speed ahead by the rearward motion. With the lever pushed outwardly a forward motion gives the high speed ahead and a rearward motion the brake. Interconnected with this lever is the ratchet retained foot brake connected with the rear wheel hub brakes.

The same chassis is used for both the runabout and the light delivery car, with the exception that in the latter the steering gear, foot pedal and side lever are moved up forward as shown in the photo.

The runabout bodies are all ironed for tops and have at the rear of the seat, and extending forward under it, a carrying space of considerable size for so small a vehicle. Instead of placing a deck over the space in the rear of the body, this is covered by a waterproof fabric covering which matches the coloring of the car. This is done so that a considerable degree of flexibility in the size of the carrying space may be had if desired.

The prices quoted above, $500 and $550 with solid and pneumatic tires respectively, does not include tops, lamps or horn. The company furnishes tops at $30, side and tail lamps, as shown in the photo of the runabout, for $15, and large dragon horn, as shown, for $5.

ON THE ROAD.

Because of the careful balancing of the engine reciprocating parts, the motor runs light with surprisingly little vibration; and when the car is under way none is felt. The writer rode in both a test car and a car ready to be delivered, and in each case the remarkable freedom from vibration and the soft action of the speed clutch engagements was very marked. In running over some of the unpaved streets north of the Detroit Boulevard ample opportunity was found for testing the behavior of the clutches and the flexibility of the engine. After being seated in the car and getting under way, at which time the low speed was used, no running was done on other speeds than high. When running this way the control of the car is exactly similar to that of a car with sliding change gear and master clutch, and at no time was it necessary to make use of the side lever.

The engine showed considerable flexibility, and in each case, after a slow down for traffic or rutty roads, got away again with great celerity and smoothness.

The test car, which was fitted with solid tires, was the one used for the running on rutty and unpaved roadways, and it was very interesting to watch the action of the front helical springs and shock-absorbing radius rods. These were in continuous action, except when on smooth pavement, and their great flexibility and sensitiveness, combined with the radius rod devices, effectually dampened road vibration. In spite of the low gearing of tnis car it skimmed along at a great rate—as testers always drive. On the one occasion when it was necessary to use them quickly, the brakes showed themselves to be smooth acting and very powerful.

While the writer can give no figures from personal observation of the fuel consumption and running economy of these cars, the authenticated averages of the four runabouts which recently participated in the Brush Reliability run are here given as an indication of average performance.

The averages given below are for four cars; that is, the mileages, fuel consumptions, oil consumptions, repair costs, etc., for all four have been added together and averages struck as if the performance of one car only were being considered:

Total mileage for four cars	6,587.5
Total gal. gasoline, four cars	292.5
Average miles per gal. gasoline	22.5
-otal oil quarts, four cars	64
Average miles per qt. oil	103
Total time in days, four cars	80
Average miles per day.	82.3
Total repair cost, four cars	$5.80
Average miles per 1c repair cost	11.3
Average repair cost per mile	$.000884 or .0884c

A BUSINESS SURREY OF SIMPLE CONSTRUCTION

A simple constructed, substantial business man's car, was recently brought out by The Overholt Co., of Galesburg, Ill., makers of the Overholt miter box. It has been the aim of this company in designing the Overholt motor car to produce a machine that would satisfactorily replace the old family horse and buggy as regards simplicity, reliability and price. No radical departures from accepted practice have been attempted and the construction is standard throughout. The wheels, axles, steering apparatus, frame, engine and other main parts are made by the Overholt Company and the accessories used are all of well-known make, including a Buffalo carburetor, Kingston muffler, Essex oiler.

The "Overholt" Air-cooled, Friction Drive Motor Surrey. Price $650. Also furnished as a single seat runabout at $600.

Power is furnished by a 2-cylinder, opposed, air-cooled gasoline motor. Speed changes are obtained by means of friction discs this type of speed change having been adopted because of its simplicity. Drive to rear axle is by a 1-inch pitch Baldwin roller chain. Rockwood friction fiber is used on the friction disc which runs against an aluminum disc the thrust of which is taken by a spring, insuring equal pressure. The thrust is carried by ball bearings to reduce friction.

The motor cylinders are 4⅛x4 inches and develop 12 to 14 horse power. The motor is placed in front under the hood and its flywheel is cast in fan form to aid in cooling the cylinders. Ignition is by jump spark, dry cells furnishing the current. An oil pool is maintained in the crank case for splash lubrication and a force feed lubricator supplies the cylinders and main bearings.

The tubular front axle is fitted with drop forged steering knuckles and arms. The steering gear is of the spur gear and segment type and is very simple.

The wheel base is 86 inches and the gauge 56 inches. The wheels are of the artillery type the front wheels being ball bearing. Solid, 1½-inch Firestone, side wire tires are regularly fitted. Pneumatic tires will be furnished on special order at extra cost. Four full elliptic springs carry the body. The rear seat is removable and without it the car is adaptable to light delivery purposes. The body is 75 inches long, allowing ample room for passengers when both seats are used or for baggage or merchandise when only one seat is used.

As a surrey this machine is sold for $650 and as a runabout for $600. It was not the designer's attention to produce a speed car but the machine shows up satisfactory in this respect being capable of doing 30 miles per hour. The demonstrating car has been run about 4,000 miles during the past summer in ordinary business use during the day and for pleasure riding at night and on Sundays. It has hauled loads as heavy as 600 lbs.