The Warner GUARANTEE

We guarantee the Auto-Meter to be ABSOLUTELY ACCURATE when purchased and to remain so for a period of one year.

We will, however, test your instrument for accuracy at any time WITHOUT CHARGE if sent to our factory express prepaid.

We further guarantee the Auto-Meter, the driving shaft and all connections against defects in material and workmanship for a period of one year from date of purchase.

PLEASE NOTE—that guarantee is not effective where the instrument has been injured by accident, or where the case has been opened and the parts been "tinkered" with.

The Warner Instrument Company
Beloit, Wis., U. S. A.

The Principles of Speed Indication

As applied to the Automobile

H CUNTZ 1910

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The AUTO-METER

The Warner Instrument Company
Beloit, Wis., U. S. A.

THE PRINCIPLES

OF

Speed Indication

As Applied to The

Automobile

The Warner Instrument Co.
Beloit, Wis., U. S. A.

The Only Way to Indicate Actual Speed

THERE are numerous makes of speed indicators for automobiles, but there are only two principles used in them.

One is the magnetic induction principle, which we control by several patents. The other is the centrifugal principle, which no one controls.

Every speed indicator operates on one of these principles.

The difference in the cost of speed indicators is not due to the difference in principle. It is due solely to the variation in workmanship and materials.

A good speed indicator is built like a watch. It is made with watch machinery and by men skilled in watch making. Perfection requires fine adjustment and infinite care.

But one watch sells for $1.00 and another for $100. Both are called watches, but there is a very great difference in the service they render.

So in speed indicators. A centrifugal instrument, if properly made, costs just as much as the Warner. Yet there are centrifugal instruments which, like cheap watches, cost considerably less.

But the question to decide in a special indicator is not the question of price. That depends solely on workmanship. A poorly-made indicator of *any sort* is utterly worthless. In a very short time it will fail to make even a good guess at speed.

The question is wholly between those two principles—the centrifugal and the magnetic. So the purpose of this book is to discuss these two principles.

We are going to prove first, that no centrifugal instrument, however well made, can be accurate.

The registering of low speed is impossible with them. The registering of higher speeds is never exact.

As the instrument wears, the variation increases until the speed showing becomes simply ridiculous.

The centrifugal instrument utterly fails to accomplish what it is made for. And a speed indicator which doesn't indicate speed is of no more value than a dummy watch.

We are next going to prove that the Warner Auto-Meter is absolutely exact, and that it always remains so.

It will indicate the speed even when the automobile is pushed by hand on the floor. And it will indicate the speed just as exactly up to 60 or 100 miles an hour.

We are going to prove this by all sorts of tests, some made by the Government, some made by railroads, some by motor car owners and some by ourselves. Then we are going to ask you to prove it yourself.

We are going to be brief, and we ask you to read what we say. For, in buying a speed indicator, these are things you should know.

The Warner Instrument Company

Beloit, Wisconsin, U. S. A.

The Centrifugal Principle Applied to Speed Indication

WITH the one exception of the Warner Auto-Meter all speed indicators are made on the centrifugal principle—the principle which makes water fly off a grindstone when revolved rapidly.

This principle has been used for years to CONTROL speed—to keep it within certain predetermined limits. It is used as a Governor for steam engines. Was formerly used on automobiles for the same purpose—to keep the engine from racing when the clutch was thrown out. For this purpose it is supreme. Nothing could be better. By tightening or loosening a thumb nut it is adjusted to a certain speed. It will hold to that speed within 50 to 100 revolutions per minute for days—sometimes weeks. Then a further adjustment quickly corrects it.

Controls Speed But Cannot Indicate It

This principle, however, as any mechanical engineer will tell you, is entirely unsuited to indicate a RANGE of speed from zero to the extreme. The tendency of the weights used in centrifugal instruments to fly off into space increases by the square of the velocity instead of evenly. It's the old problem of the speed of a falling body at any given second, which we all remember, in a slightly different form.

At low speeds the weights do not respond. Water does not fly off the grindstone until it reaches a certain number of revolutions per minute.

So on centrifugal "speed indicators" there is no indication of speed whatever until the car is moving from 5 to 10 miles per hour.

Then the uneven acceleration—the "square of the velocity"—has to be taken into account. Otherwise the dial must have the mile divisions unevenly spaced. If a division 1/8 inch long represented a mile at *one* speed the same division would have to be four times that or *1/2 inch long when that speed is doubled.* To overcome this condition coiled springs are used. When the weight or weights reach a certain speed, a spring comes into play and holds them back until they reach a still higher speed. (See illustration page 7.) Then another acts as a further retarder.

Uneven Acceleration

These coiled springs have short bends and are necessarily small and weak, compared with the heavy, continuous work they have to

do. Therefore, they soon lose their strength and *there is no way of tightening or adjusting them.*

Perhaps you have a family spring scale at home. Ask whoever uses it how often that spring must be tightened to make it weigh a *true pound*, even though it is used but seldom. Then imagine yourself thumping that scale with your hand 100 or 200 thumps a minute—and doing it hour after hour—day after day—as many hours as your automobile is on the road.

That is practically what is being done to the coiled springs in every centrifugal "speed indicator". These springs are far more delicate than those used in a spring scale.

The conclusion is obvious. When springs weaken the centrifugal "speed indicator" becomes so grossly inaccurate as to be worthless. Then it must be thrown away for *there is no means of tightening those springs.*

The weight or weights used in centrifugal instruments take up so much room that the remaining parts must be so small and delicate as to wear quickly. The revolving motion of the weights must be changed to that of a pendulum, to permit the use of a hand which can swing back and forth over the spaces indicating miles. This change is made to a cam (see illustration Page 8, Fig. 8). This is of metal, the size of the little finger nail of the average adult—and is but little thicker. This cam rubs against a steel pin (unsupported at one end) but little larger than a pin shank. This pin forms part of a link connecting with the indicating hand.

Where Wear Causes Inaccuracy

The scraping of this pin against the cam soon wears it. This wear is multiplied through the long indicating hand by dozens of times. Wear the thickness of a business card in the cam, becomes ONE-QUARTER OF AN INCH when transmitted through the indicating hand.

We have taken apart dozens of centrifugal instruments which have been cast aside—some of them used only a few hundred miles—and in every instance *the bottom of the case was sprinkled with fine metal dust*, which could come from only one place. This metal dust tells an interesting story without words.

The weight or weights used in centrifugal instruments are not —cannot be—perfectly balanced, any more than can a one-cylinder automobile. There is continuous vibration, increasing with the speed, which when multiplied through the cam and connecting link causes the indicating hand on all instruments made on this principle to flutter back and forth over a space representing 5 to 10 miles on the indicating scale. The supposed speed is somewhere in between. It requires a clever reckoner to tell just where. And when, as occasionally happens a centrifugal instrument is found on which the hand *does not* vibrate, it means that the springs are set up tight and used as brakes, thus *destroying* sensitiveness. Such an instrument indicates by jerks. The indicating hand will jump from zero to say 10 miles—then to 15—then to 25. No intermediate indication is shown.

Vibration Makes a Correct Reading Impossible

The above paragraphs touch upon weaknesses and defects which exist in all "speed indicators" operating on the centrifugal principle. All are made on this principle with the one exception of the Warner Auto-Meter.

These weaknesses and defects exist in all instruments made on the centrifugal principle irrespective of how carefully the instrument itself may be made or how much time and expense is devoted to refinement in its construction.

Whether a centrifugal instrument costs $15 or $150 the same deficiencies are there.

In the higher priced instruments the parts are made and assembled by skilled workmen using jewelers' machinery and every attention is given to making centrifugal principle do its best. These instruments are worked over for hours to make them as accurate as the principle will permit when sent out.

Difference Between High and Low Priced Instruments

In the low priced instruments this expensive labor and adjusting is necessarily omitted. The parts are assembled as stamped out by a die, or as they come from the casting room. Such instruments may be approximately accurate when you get them or they may not. It's your luck, or the contrary. If you are fortunate, the low priced instrument will serve equally well as that at the higher cost.

And with equal certainty, will either instrument, because of the principle on which it is made, become so inaccurate as to be worthless after an extremely limited period of service.

The centrifugal principle while almost perfect for CONTROLING speed, fails totally to indicate a complete RANGE of speed with anything more than approximate accuracy *even when new*.

The Centrifugal Speed Indicator Dissected

WE show herewith a wash drawing showing the general construction of a speed indicator. Instruments of different makes may differ slightly in details, but the principle and its application are the same.

Fig. 1 is the end of a solid shaft which connects through a flexible shaft with the front wheel of an automobile. When this shaft turns, the weight (Fig. 2) revolves with the shaft and as speed increases, centrifugal action tends to make it assume a position at right angles with the shaft — in other words, to stand up instead of laying down as in the illustration.

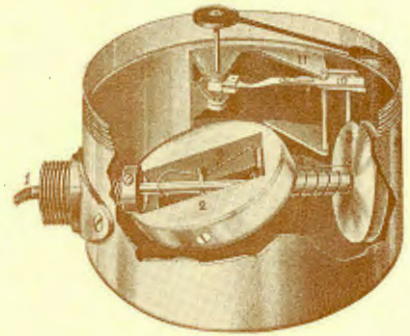


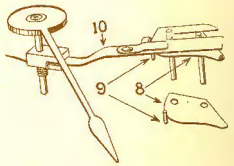
Fig. 3 is a spool of brass, attached to a tube which slides freely on the shaft. This spool is connected with the weight by a link or wire (Fig. 4) and revolves with the weight.

As speed increases and the weight straightens up, the link or wire (Fig. 4) pulls the spool inward. This pull is resisted by the coiled spring (Fig. 5). When greater speed straightens up the weight still more, spring No. 6 comes into play, first one leg of the spring and then the other (which could not be shown) pressing against the little bar shown at the end of the spring.

Between the lips of this spool (Fig. 3) in the illustration rests a pin (Fig. 7) which connects with a thin cam of brass (Fig. 8) at the top and is unsupported at the bottom. As the spool is pulled inward by the weight, the outer lip of the spool rubs against this pin (Fig. 7) and thus moves the cam. This rubbing soon wears away the lip of the spool.

Where the Greatest Wear Comes

As the cam moves it presses against the little steel pin (Fig. 9) and thus pushes the link (Fig. 10) to the left. This causes the indicating hand to move over the divisions on the dial.



If you will figure the "gearing up" between the pins—No. 7 and No. 9—and the tip of the indicating hand, you will easily see how wear, the thickness of a business card at *either point*, will be multiplied into a *quarter of an inch or more* at the point of reading.

This amount of wear may be expected in a comparatively short time.

The weight (No. 2) is lead. The bracket (No. 11) is also lead or composition. The pins, springs and shaft are steel. The remaining parts are brass.

The Magnetic Induction Principle of Speed Indication

THIS principle is used in but one speed indicating instrument—the Warner Auto-Meter.

We control the application of this principle to speed indication by several patents.

All other instruments designed to indicate speed are made on the Centrifugal Principle, considered in the preceding chapter. No one controls this. Any one can use it.

The Magnetic Induction Principle, used exclusively in the Auto-Meter, is what drives street cars, electric automobiles and machinery of all kinds when electric power is used.

But as applied to the Auto-Meter the drag or "pull" of a permanent magnet is utilized instead of that from an electric magnet.

This electrical pull is always fixed and unchanging. It increases in direct ratio with the speed instead of by the square of it (as in centrifugal instruments.)

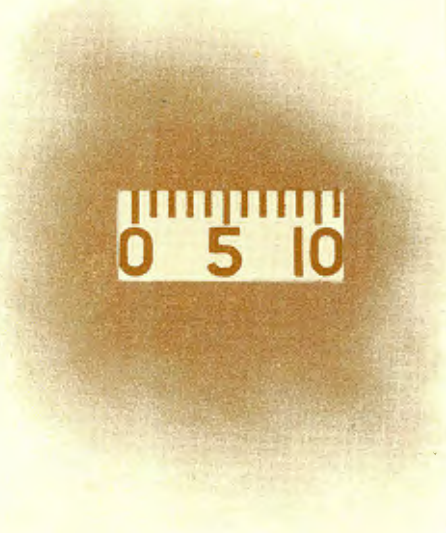
Which means that if a magnet revolving at 10 revolutions per minute exerts a drag or pull of one pound, the drag will be doubled (to two pounds) when the speed is doubled (to 20 revolutions) and all intermediate points in the same proportion.

This is one of the well known electrical laws.

The Auto-Meter consists of but two main parts—a magnet, which revolves, and an aluminum cup which forms the armature on which the inductive force of magnetism is exerted.

The magnet is connected with the flexible shaft which attaches to the front wheel of the automobile. It is mounted on imported Hoffman ball bearings.

The aluminum cup carries the speed indicating scale. It is mounted on a pivot of special steel and is carried on four sapphire bearings in exactly the same manner as the balance wheel of an expensive chronometer. Only diamonds are harder or more wear resisting.



The Indicating Dial of the Auto-Meter. Note how large and readable are the figures.

Attached to the pivot carrying the aluminum cup is a hair spring which resists the "pull" of the magnet and returns the speed scale to zero when the magnetic "pull" is removed.

Please note that this is the *only spring of any kind* used in the Auto-Meter—and that it is a *hair spring*—of the same kind and grade as used in a high grade watch.

The Only Spring Used is a Hairspring

It is *eighteen inches long* when pulled out straight. In a watch or chronometer the hair spring resists the pull of the main spring (instead of magnetism) and returns the balance wheel to the central or zero position *18,000 times* each hour, 24 hours each day. It continues to do this for *an average lifetime* without losing in strength a particle. The hair spring never weakens in a watch or chronometer—nor in their counterpart—the Auto-Meter.

Perfect Balance — No Vibration

Magnetic "pull" is a constant, even, unvarying force. The magnet itself acts as a perfectly balanced fly wheel. There is no vibration (as in centrifugal instruments.) Therefore, the speed indicating dial is always as steady and readable as the hands on your watch. The construction is such that the jolting or swaying of the car has no influence on it. SPEED ALONE can move it.

The Permanent Magnet Used in the Auto-Meter

Indicates Every Range of Speed

And because this magnetic "pull" acts on the aluminum cup armature in direct ratio to the speed of the magnet; *the slightest movement of this magnet causes the dial to indicate.* Thus your speed is correctly indicated when your car is pushed ahead on the garage floor. And is shown with equal correctness when you are driving as fast as you dare.

A practical illustration of this supreme accuracy at the lowest of speeds is found in the case of the Victor Talking Machine Company. They use a special Auto-Meter to time the speed of records while being made. These records normally make 76 revolutions per minute. The Auto-Meter enables them to correct *variations of less than 1 per cent.* Think of what a wonderful example of supreme sensitiveness and accuracy.

Note also that because of the magnetic induction principle upon which the Auto-Meter is made, no intermediaries are required between the driving mechanism (the magnet) and the indicating dial.

The magnet and the aluminum cup are normally 1-16 inch apart. There is nothing but *air* and the unseen force—*magnetism—between.* No short coiled springs with sharp turns—no pins—no cam—no sliding friction of any kind—nothing to rub and wear and thus cause inaccuracy. There are but two moving parts. These revolve—one on imported Hoffman ball bearings, the other on double sapphire jewels. Friction is therefore nil in the Auto-Meter.

A Demonstration

Before the Auto-Meter is assembled in the case, hold the magnet bearing in the fingers and start the magnet turning. Take the indicating dial case in the other hand and gradually bring the two parts together. The speed dial will indicate as shown when a full quarter inch separates the parts.

The Magnetic Induction Principle worked out with these niceties of construction, makes the Auto-Meter so enduring that it has withstood the equivalent of a MILLION MILES of the hardest kind of driving without perceptible wear or appreciable variation from absolute accuracy.

The Auto-Meter, besides being the only accurate speed indicator and so well made that it will STAY ACCURATE, is also the *only speed indicator which can be adjusted in case of accident or mishap.*

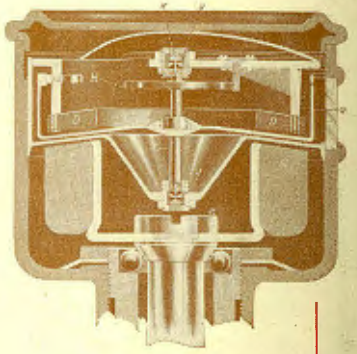
Centrifugal instruments when they become inaccurate from any cause must be thrown away, or entirely rebuilt.

The Magnetic Induction Principle is the only principle yet discovered which makes possible the accurate indication of a complete RANGE of speed from zero to the extreme. The Auto-Meter alone can use this principle.

The Auto-Meter Dissected

THE accompanying cut shows a cross section of all models. The case alone of 1909 model is different.

C—Shows the Permanent Magnet illustrated in perspective on page 10. This is attached as shown to a short steel shaft, which in turn connects with the flexible driving shaft. The Ball Bearing parts as shown are ground and lapped until they are perfect. When assembled, no perceptible "play" can be felt, yet the magnet spins as freely as though no bearing were there and the parts were being simply twirled in the fingers.

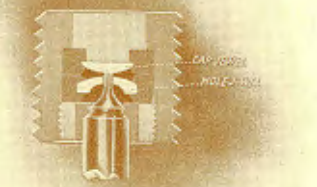


D— is the "field ring"—a ring of steel which is attached to the upper part of the case. This ring is used to concentrate the magnetism and give a more powerful pull on the dial (G) which is a shallow aluminum cup carrying the indicating scale. This scale-cup is carried on a special steel pivot (F) tempered to an extreme degree of hardness. The bearing points are then ground and lapped on special jewelers' machines costing $600 each, until they are accurate within 1-10,000 inch. Then are polished until no dullness can be detected under a very powerful microscope.

H— is the Spiral Hair Spring which pulls the scale back to zero when the magnetic "pull" stops.

J— is the hole-jewel and K is a cap jewel of sapphire. Only diamonds are harder.

These jewels are highly polished on special machines and the holes in the hole jewel must be perfect within 1-10,000 inch or the jewel is rejected. The AUTO-METER IS THE ONLY SPEED INDICATING INSTRUMENT ON WHICH JEWELED BEARINGS ARE USED.



These jewel bearings are mounted in a substantial setting (see illustration.) The dial case is polished and then GOLD PLATED before assembling as a precaution against possible corrosion, and to make certain that not even a CHEMICAL change can take place inside the Auto-Meter once it is assembled, to possibly disturb its wonderful accuracy.

Not only is the principle on which the Auto-Meter is made the *only correct one* for purposes of speed indication, but in utilizing this process, advantage is taken of every *refinement of construction* which makes for greater durability and more everlasting ACCURACY.

Convincing Tests Which Show Enduring Accuracy

THE U. S. Government after the most extreme tests has used several hundred Auto-Meters connected up with a regular Anemometer to show the *speed of the wind* in miles per hour.

These are distributed among the military posts and are used to improve the marksmanship of U. S. Soldiers and the Marines and Gunners of the Navy.

Wind pressure influences accurate shooting to a marked degree. This was formerly estimated by means of flags. Every marksman "estimated" differently. The best guesser was the best shot. The Auto-Meter removed all doubts and solved the problem. Since the Auto-Meter was adopted for this purpose, our soldiers and marines have won against every country in accurate marksmanship.

The following is a letter verbatim, written by the chief engineer of the American Brake Shoe & Foundry Co., which gives the details of a test for accuracy in all divisions of speed from zero to 80 miles per hour so severe that they themselves were astounded to find that any speed indicating instrument could stand the test.

GENERAL OFFICES
AMERICAN BRAKE SHOE & FOUNDRY COMPANY,
MAHWAH, N. J.
November 21, 1908.

WARNER INSTRUMENT COMPANY,
1902 Broadway, N. Y.

Gentlemen:

Responding to your request of Nov. 17th to our Mr. W. H. Chadwick, I take pleasure in advising you of the very satisfactory performance of the Warner Speed Indicator which you supplied us for our brake shoe testing machine, illustrations of which I enclose. This machine was fully described in the issue of the Electric Railway Journal of June 27th. Unfortunately, at that time we did not have your device installed, but future illustrations will show clearly as per photograph attached.

By computation from the chain gearing we calculate that our paper will move under a marking pen through a space of .0012635″ for each inch a point moves on the face of a 33″ wheel.

A speed of one mile per hour means 17.60 feet passed over per second. Now, a motion of the pen on the wheel through 17.60 feet corresponds to .0222376″ per paper travel. Consequently, if we mark second intervals on the paper, the distance between these marks divided by .0222376″ (or which is the same thing) multiplied by 44.97, will give us the speed the wheel is traveling during that second, in miles per hour.

We have a very accurate clock with a pendulum vibrating seconds, and a fine point at the extreme end of the pendulum passes a globule of mercury and completes the circuit at each stroke, operating an electro-magnate making a record on paper. All we have to do then is to measure the distance between the second marks to give us our speed in miles per hour at that particular point, and by plotting the ordinate equivalent to the speed in miles per hour we can readily draw out the retardation curve from the chronographic record.

To test your speed indicator, we ran the machine from a speed of 80 miles an hour down, and marked on the paper as it moved under the pen marking seconds, the exact point at which your instrument gave an even speed, and we find that our paper record checks your machine as close as we can measure.

I enclose a roll of indicator records, where you can see for yourself the actual results, and I can assure you it is a great satisfaction to have our machine equipped with your speed indicator and I take this opportunity of thanking you for the many courtesies extended to our representative. Should you care to see our machine in operation, we will be glad to show it to you at our laboratory at Mahwah at any time you may come out, and I shall take pleasure in expressing to those who inquire the sentiments indicated in this letter concerning the satisfaction obtained with the Warner Speed Indicator.

Yours truly,
(Signed) F. W. SARGENT,
Chief Engineer.

The Auto-Meter is installed in the private cars of the Railroad Superintendents of some of the best known roads in the United States.

The Auto-Meter is in the Engine Cabs of Locomotives where a certain speed must be maintained on a severe time schedule under penalty of great loss to the road.

From queries and correspondence now under way, the Auto-Meter will in the near future be part of the regular equipment of every locomotive and observation car on every first-class railroad in the country.

The General Superintendent of an important railroad system voluntarily gave us this information in November, 1908. He was riding over the road with a Division Superintendent, watching the mile posts and comparing with the Auto-Meter. They checked exactly for nearly an hour's riding. Then three posts failed to check. He mentioned this fact to the Division Superintendent and was informed that these three posts had been set wrong because of an error in surveying—that the discovery had been made several months previous. Surveying, because of the human element connected with it, is sometimes incorrect. The Auto-Meter is unfailingly accurate.

The fastest motor boat in the world—the Dixie II.—is admitted by its owners to have won this position largely because of the special Auto-Meter (designed to show revolutions per minute) with which it was equipped. By means of the Auto-Meter the speed of the engine was kept constantly at the miximum revolutions per minute—its full capacity. So close was this race that it was figured that a falling off of only *a few revolutions of the engine per minute* would have lost it.

The above uses are mentioned in advance of automobile achievement because of the thorough, exhaustive tests of unheard of severity which preceded their adoption. The motorist is inclined to take things for granted—is often swayed by unsubstantiated claims to his own undoing. Neither the Government, the Railroads or the companies mentioned do things this way. They must be shown *beforehand* that an article will more than meet every demand which will ever be made upon it before it is adopted.

In the Automobile field we shall not attempt to give details but merely state FACTS. The instruments in the hands of the users mentioned were in each case bought and paid for. The character of these users will be sufficient indication that they use the Auto-Meter because it is BEST—most accurate and most reliable and for no other reason.

Mr. C. J. Glidden of "Glidden Tour" fame, uses the Auto-Meter on all his cars. It has accurately indicated his speed and mileage in all parts of the civilized world.

W. K. Vanderbilt, Jr., donor of the "Vanderbilt Cup", uses the Auto-Meter on his pleasure and racing cars.

The maps in the Official Automobile Blue Books were laid out by the Auto-Meter.

Sidney J. King, famous throughout the automobile world for his reliable Auto-Maps, has always used the Auto-Meter in compiling them.

The Motor Guide Maps were all compiled through the aid of the Auto-Meter. The maps and guides published by the White Company were also compiled by using the Auto-Meter over the roads which are shown.

The fire chiefs in New York, Boston, Chicago, Detroit and Denver have their cars Auto-Meter equipped.

The Thomas "New York to Paris" car, because it had the Auto-Meter as a constant and reliable pace-maker, was able to distance all competitors.

The Trans-Continental Franklin was Auto-Meter equipped, likewise the Trans-Continental Lambert, also the Reo Mountaineer.

The famous Oldsmobile "Mudlark", which traveled from New York City to Dayton, Florida, used the Auto-Meter as an aid in picking the way.

The demonstration car of the Diamond Rubber Co. went 7831 miles over ice, mud and snow-covered roads. The Auto-Meter was as accurate and reliable at the end as it was at the beginning.

These illustrations could be continued indefinitely. Suffice it to say that the Auto-Meter is on the dashboard of *64 per cent of all cars costing $2,000 or more on which a speed indicator of any kind is used.*

For unfailing accuracy and wonderful durability the Auto-Meter stands alone. It has no competitors.

The Warner Odometer

THE 1909 Auto-Meter is equipped with the Warner Odometer. This is of our own construction and is as accurate, durable and dependable as the Auto-Meter itself.

It is made on a similar principle to the fare register used in street cars. It is positive in its action and cannot become inaccurate through use. One of these Odometers has been driven by electric motor for 400,000 miles without showing perceptible wear or getting out of adjustment in the slightest.

The figures are large enough to be easily read from the seat.

The Season Dial registers 100,000 miles and repeat. Other odometers register 10,000 miles only. Some motorists exceed this mileage in a single season. Their future mileage is lost.

The Trip Dial registers 1000 miles and repeat. Other Odometers register 100 miles only.

The trip dial resets to zero by a single turn of a button. On other button-set odometers it takes from 10 to 40 turns to reset. The push-button reset is unreliable, soon getting out of adjustment.

The Warner Odometer is the only self-contained odometer the figures of which are not concealed in whole or in part by the speed indicating hand.

Odometer troubles are over for the motorist whose car is equipped with the Auto-Meter.

The Warner Flexible Shaft and Spiral Gear Drive

THE Warner Flexible Shaft (patented) has proved so wonderfully durable that it is being adopted for many outside uses. The illustration shows its construction. It combines great flexibility with a minimum of strain and transmits power with little perceptible loss. It has none of the defects of the wire cable drive,

The Warner Spiral Gear Drive

The spiral gear and interior parts run in grease, eliminating friction. Note the open teeth in the outside gear, which prevent clogging with mud, dirt or stones

The Warner Driving Shaft

A—Nut to connect flexible shaft with magnet shaft of the instrument.

B—Heavy re-enforcing casing. As an extra protection this is now jacketed with leather to a point below where it normally passes through the floor of the car.

C—Regular flexible brass casing.

D—Steel lining.

E—The shaft itself showing unique form of links, permitting the shaft to be driven when coiled in a 10-inch circle.

used on most instruments which soon crystalize. Then the wires break and it must be replaced.

The links in this shaft are of special steel cyanide hardened. Each shaft before shipment is rigorously tested and known to be perfect.

One of these shafts has been run 160,000 miles in the Warner Factory without showing the slightest wear when taken apart for inspection.

This construction makes the Warner driving shaft the strongest and most durable device of its kind in existence—better qualified than any other to withstand the strains to which a speed indicator shaft will be subjected. Yet, notwithstanding this extra strength, the Warner shaft used to drive the Auto-Meter is required to make only ONE-QUARTER THE REVOLUTIONS of the driving shafts of practically every other speed indicator made. Think what this means — long life and freedom from trouble.

The Spiral Gear Drive (see illustration) connects the flexible shaft with the wheel.

It is dust-and-water tight and the interior gears run in grease so that friction and wear are practically eliminated. This construction permits the transmission of power at right angles without bending the flexible shaft.

The outside gear, which connects with the wheel gear is cut from steel and case-hardened. It will be noticed that the teeth of this gear are open (construction patented) so that any mud, dirt or small stones which may get into these teeth are pushed through and can cause no injury to the gear or connections.

The Warner Attachments

WE have individual fittings and attachments for all standard makes of cars. When ordering direct or through a dealer or branch house all that is necessary is to give make and model of the car, diameter of front wheels and size of tire, and the instrument will be furnished with *fittings that will fit* and a circular will be sent showing how any chauffeur or owner can attach to the car without filing or other fittings.

The Warner Test For Accuracy

HERE is a specially constructed machine used to test and adjust the Auto-Meter. It cost $10,000.00 to build. It detects variations of ONE ONE-HUNDREDTH OF ONE PER CENT.

This machine is erected on a thick cement foundation to secure perfect rigidity. The fly wheel at the top is of steel and perfectly balanced. It is conected to a shaft mounted on imported ball bearings and is driven by an electric motor specially constructed to secure extreme steadiness. By means of a specially constructed governor this electric motor will drive the steel fly wheel exactly 1,000 revolutions per minute. This fly wheel is positively connected with a device which *rings a bell at each thousandth revolution.* On the wall beside the testing machine is a pendulum clock, the most accurate obtainable. An electrical contact is arranged to ring another bell *every minute.*

Accuracy Testing Machine

This testing machine cost $10,000. We believe it to be the most accurate device of the kind in the world. It detects variations of 1-100 of 1 per cent.

So accurate is this testing machine that when started evenly with the clock in the morning there will not be a variation of *two pendulum beats* between the ringing of the bells at the end of an eight-hour day. This, you will admit, is pretty close to perfection.

To the shaft driving the fly wheel is connected the testing box which has ten projecting spindles each of which revolves at a different known speed. By connecting the shaft of the Auto-Meter to one spindle after the other, the instrument is perfectly calibrated—that is, it is known to be accurate at every range of speed from one mile an hour to the limit of its capacity.

This is how each Auto-Meter is tested for accuracy before it goes to you. It will never lose that accuracy but will continue to indicate speed with unvarying correctness *as long as you have a car to use it on.*

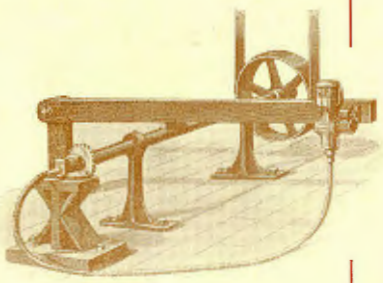
The Warner Test For Durability

NO claim is ever made for the Auto-Meter which has not been substantiated by practical tests and known to be the truth.

We have asserted that practical tests have shown that the Auto-Meter will endure a MILLION MILES of the hardest kind of riding without showing appreciable wear or losing appreciably in absolute accuracy.

Note how the test was made.

The illustration shows a home-made device, which we call our "Bumping Machine". The gear of the flexible shaft of the Auto-Meter (which normally attaches to the automobile wheel) is connected with a short steel shaft which in turn is belted to the line shaft which drives our machinery.



This "Bumping Machine" gives the Auto-Meter 200 shocks a minute, each one more severe than would be encountered in a season's riding.

The shaft of the "Bumping Machine" makes 200 revolutions per minute. Across this is a 2″x 4″ strip of maple, which is hinged at one end and has the Auto-Meter attached to the other. A knob of steel is brazed to the shaft at the point where the 2″x4″ strip touches it. At every revolution of the shaft this knob "bumps" the plank, giving to the Auto-Meter *200 shocks a minute,* while it steadily shows a speed of *50 miles per hour.*

Each one of these shocks is equivalent to *hitting a cross walk raised four inches above the road with the car going at racing speed.*

Your automobile wouldn't give the Auto-Meter such a shock in an entire season's riding. Yet we give it 200 such shocks a minute, day in and day out.

Yet notwithstanding these severe continuous shocks the speed dial *stands as steady as though fixed in place.* We have often had to slow down the machinery to make visitors believe that it was *really indicating* and was not permanently fastened.

We refer to this test simply to convince you that we are not speaking at random when we assert that the Auto-Meter will withstand a MILLION MILES of the hardest kind of riding without wear or losing in accuracy.

The 1909 Auto-Meter

Model K — 60 mile scale
Model L — 100 mile scale

THE 1909 Auto-Meter is now mounted in a circular case as shown, and is equipped with the new Warner Odometer which registers 100,000 miles on the Season Dial and 1,000 on the Trip Dial. A single turn of the button at the left resets trip dial to zero.

The case in circular form possesses the advantage of setting up closer to the dash and is easier kept cleaned and polished than earlier models.

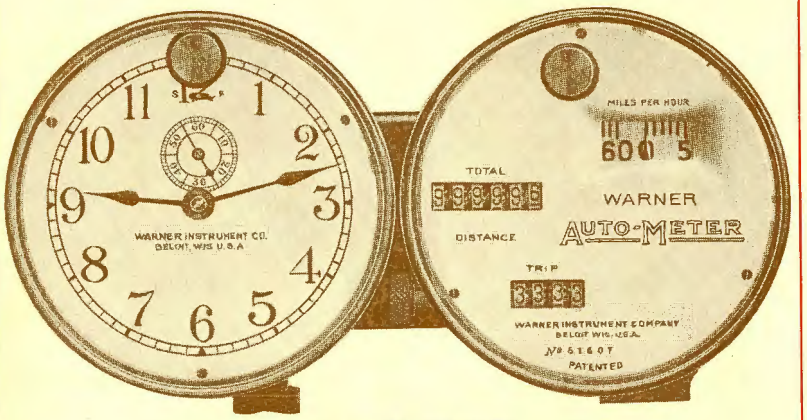
Model M — 60 mile scale
Model N — 100 mile scale

This construction also permits the installation of a concealed electric bulb under the glass cover, which illuminates both speed and distance figures when riding at night.

Time is also made readable at night by an electric bulb at the top.

The speed indicating mechanism is exactly the same in every particular as used in all former models. It was and always has been perfect, and is susceptible of no improvement.

This instrument is guaranteed accurate when you get it and to remain accurate FOREVER or it will be made so or replaced.

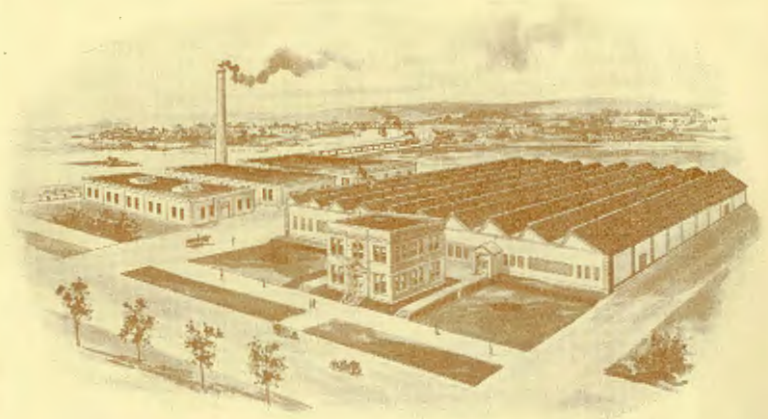


Model O — 60 mile scale
Model P—100 mile scale

The Warner Factory

THIS is the Warner Factory in Beloit, Wis., where the Auto-Meter is made. It is constructed from cement and pressed brick. Only the doors and floors are wood.

The windows are sealed air tight. The outside doors are nearly so.



All the air which comes into the Warner Factory is taken in through a large sheet steel pipe, drawn through a spray box in which a wide spray of water is continually falling. This thoroughly *washes the air* and rids it from all impurities. The air is then dried and circulated by a blower through large galvanized iron pipes to all parts of the factory.

The spray of water removes every atom of dust or soot from the air before it can enter. Every evening from one to two buckets of mud, literally sprinkled with flies, mosquitos and gnats are removed from the spray box. They have been washed out of the air. Yet the air of Beloit is exceptionally clear and pure.

The finest Jewelers' machinery is used in the Warner Factory. These must produce parts accurate to 1-10,000 inch. Therefore, this precaution is wise. It is only one of the many features which have an influence in making the Auto-Meter an instrument of absolute unfailing accuracy.

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