

Jan. 10, 1950

C. L. STANCLIFF

2,493,783

MECHANICAL SILENT TAPPET

Filed July 17, 1945

3 Sheets-Sheet 1

Fig. 1

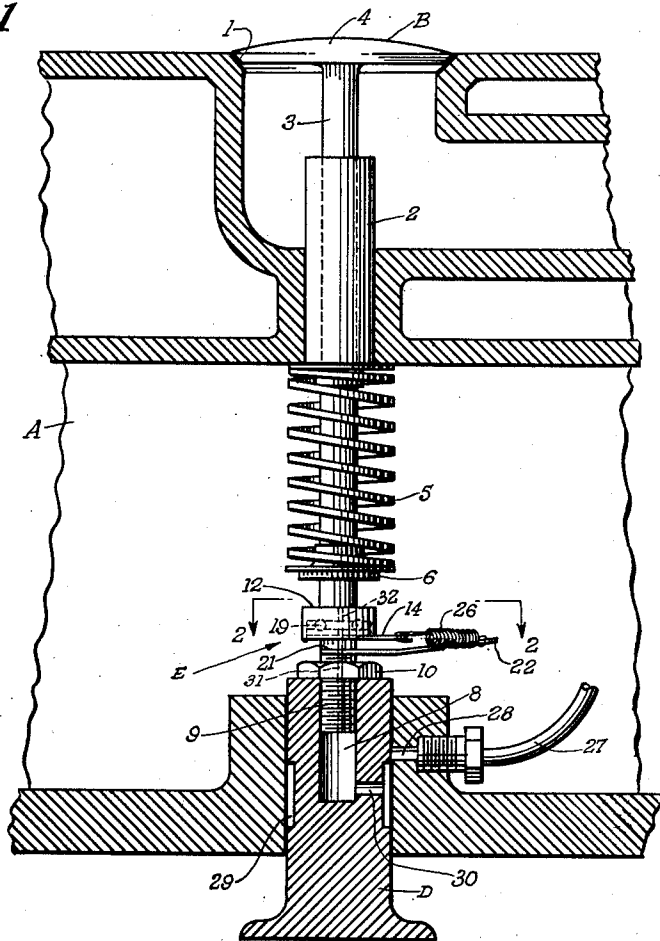


Fig. 8

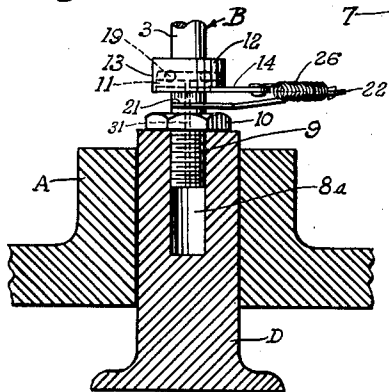
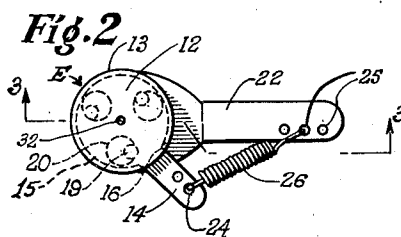


Fig. 2



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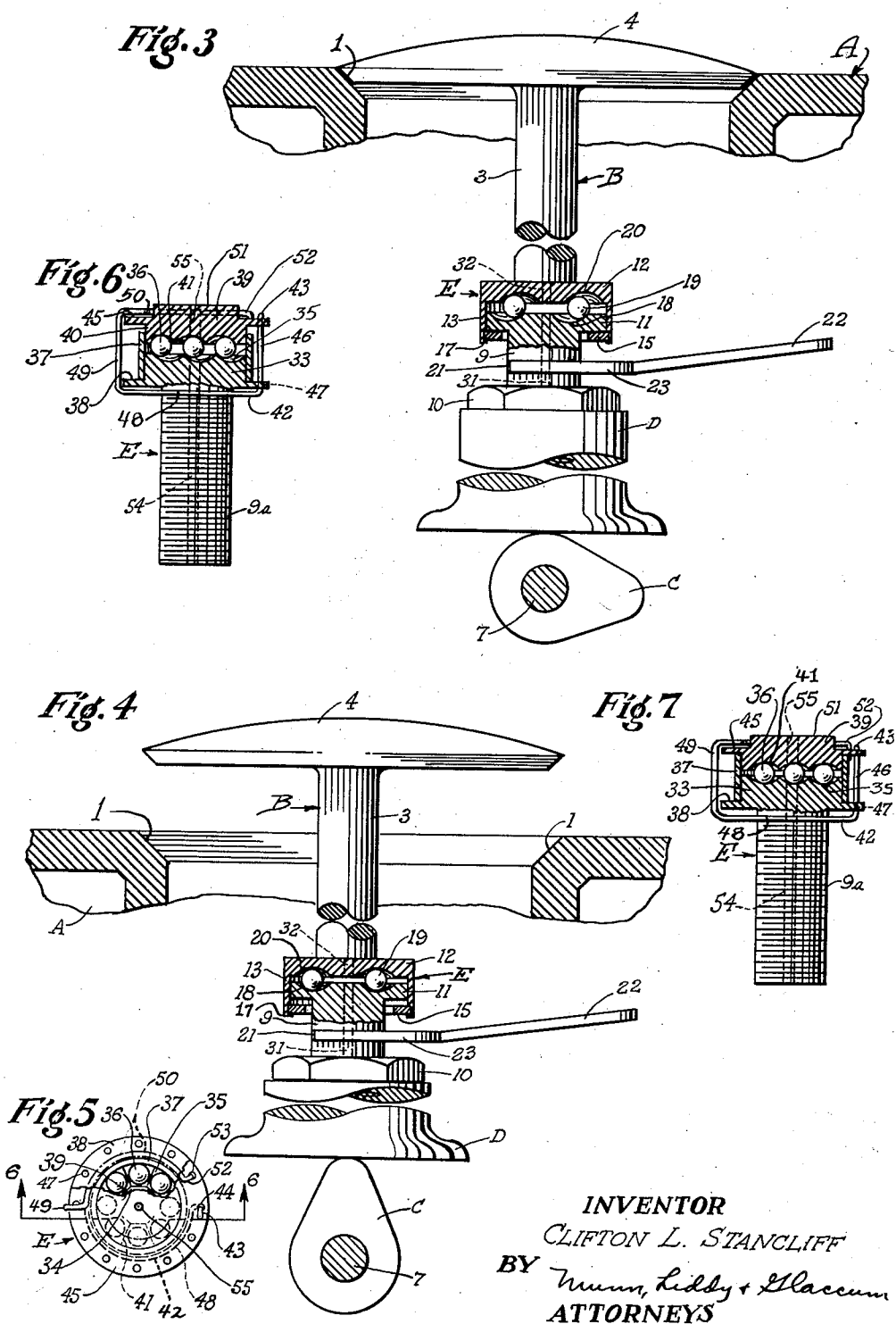
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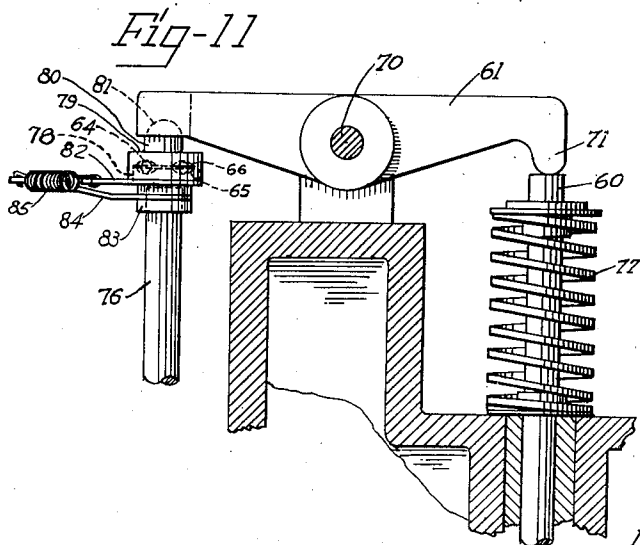
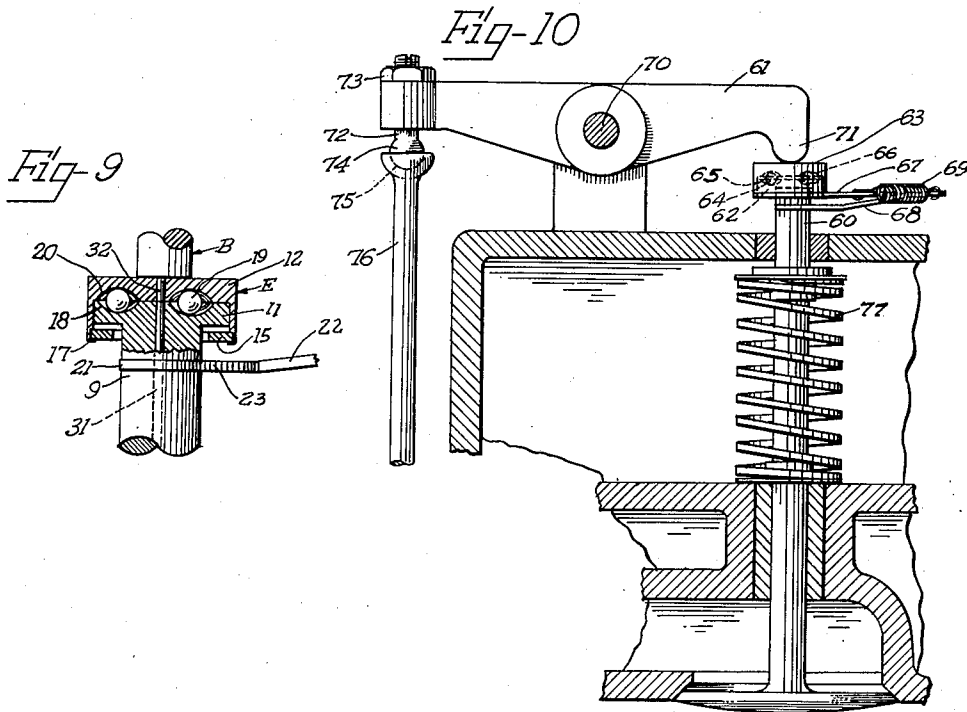
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3 Sheets-Sheet 3



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2,493,783

MECHANICAL SILENT TAPPET

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Application July 17, 1945, Serial No. 605,564

9 Claims. (Cl. 123-90)

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An object of my invention is to provide a silent mechanical tappet in which the space between the bottom of the valve and the top of the tappet is taken up at all times by a sleeve expanding device that will permit the tappet to function in the normal manner and yet be noiseless. The device automatically compensates for wear between the valve stem and the tappet and it may be readily installed without any alternations being necessary in the automobile engine. My silent tappet takes the place of the standard tappet and the only operation necessary to equip an engine with my device is to remove the standard tappet and screw my device into its place.

A further object of my invention is to provide a device of the type described which is simple in construction and durable and efficient for the purpose intended.

Other objects and advantages will appear in the following specification, and the novel features of the device will be particularly pointed out in the appended claims.

My invention is illustrated in the accompanying drawings forming a part of this application, in which:

Figure 1 is a vertical section through a portion of an internal combustion engine and shows my device operatively applied to the valve lifter and contacting with the valve stem;

Figure 2 is a top plan view of my device and is taken substantially along the line 2-2' of Figure 1;

Figure 3 is a vertical section taken along the line 3-3' of Figure 2 and shows the valve and cam co-acting therewith;

Figure 4 is a view similar to Figure 3 and shows the engine cam in raised position;

Figure 5 is a top plan view of a modified form of the device with a portion broken away for clarity;

Figure 6 is a vertical section taken substantially along the line 6-6' of Figure 5;

Figure 7 is a view similar to Figure 6 and shows the position of the parts when the engine valve is raised;

Figure 8 illustrates the device when used in connection with a grease lubricant;

Figure 9 is a sectional view showing the parts in a different arrangement, and

Figures 10 and 11 are two modifications of the device.

While I have shown only the preferred forms of my invention, it should be understood that various changes or modifications may be made within the scope of the appended claims without

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departing from the spirit and scope of the invention.

In carrying out my invention, I make use of an engine block indicated generally at A. The block has a valve seat 1 therein and a valve guide or sleeve 2. A valve B has its stem 3 slidably mounted in the sleeve 2 and has a head 4 adapted to come to rest against the seat 1. A valve spring 5 bears against a spring seat 6 which is secured to the valve stem 3. The spring 5 tends to seat the valve.

The engine block A has a cam shaft 7 on which a cam C is mounted and this cam engages with a valve lifter indicated generally at D. My silent tappet is placed between the valve lifter and the valve stem and takes the place of the standard tappet. It will be noted that the valve lifter has a threaded recess 8 for receiving a threaded shank 9 of my silent tappet indicated generally at E. The threaded shank is adjustable in the recess 8 and a lock nut 10 secures the shank in adjusted position.

Referring to Figures 2 and 3, it will be seen that the shank 9 has a head 11 and a cover 12 fits over the head and has a cylindrical flange 13 whose inner surface rotatably contacts the outer periphery of the head 11. In Figures 2 and 3 I show an arm 14 that has a ring-shaped end 15 for receiving the shank 9. The flange 13 has a recess 16, see Figure 2, through which the arm 14 projects. A swinging of the arm will rotate the cover 12 with respect to the head 11. The flange 13 has fingers 17 which are bent over the underside of the ring-shaped end 15, see Figure 3, and in this way the arm 14 is secured to the cover and the cover is rotatably secured to the head 11.

Again referring to Figure 3, it will be seen that the head 11 has a plurality of spherical depressions 18 therein and these are spaced equidistant from the center of the head and equidistant from each other. Balls 19 ride in the depressions and the balls are also received in spherical depressions 20 formed in the underside of the cover 12, see Figure 2. In actual practice I have found if the diameter of the balls is about one-half the diameter of the spherical depressions, the best results are obtained. I do not wish to be confined to any particular size or dimension of ball or recess nor in the number of balls or recesses used.

The shank 9 has a pair of diametrically opposed grooves 21 formed therein and a second arm 22 has a forked end 23 for entering the grooves. The distance between the inner edges

of the two tines of the fork is equal to the distance between the inner surfaces of the grooves 21. This permits the forked end of the arm 22 to be slid into place in the grooves 21 and the grooves will prevent longitudinal movement of the arm along the shank 9 and will also hold the arm against angular movement with respect to the shank. Figure 2 shows the arm 14 provided with a plurality of openings 24 and the arm 22 provided with a plurality of openings 25. A coil spring 26 has its ends received in any one of the desired openings 24 and 25.

The structure is such that the silent tappet can be screwed into the valve lifter D in place of the usual tappet. If there is insufficient space for the arm 22 to clear the adjacent portion of the engine block, the arm can be temporarily disconnected from the shank and then the shank can be screwed down into the recess 8. When the desired position is reached, the arm 22 can have its forked end connected to the shank and then the spring 26 can connect the two arms 14 and 22 together. In installing the silent tappet, the shank 9 is screwed down until the cover 12 clears the valve stem 3 when the valve is seated.

To adjust the tappet for running conditions of the motor, a gage having a thickness between six to ten-thousandths of an inch is placed between the tappet cover 12 and the end of the valve stem 3. The tappet shank 9 is now screwed upwardly in the valve lifter D until the pressure of the cover against the valve stem forces the balls 19 to roll to the bottoms of the spherical recesses 18 and 20, but still the tappet must not exert enough pressure to raise the valve head 4 out of the valve seat 1.

The parts are now arranged so that the valve stem can expand from heat created by the running of the engine, and this expansion will not raise the valve from its seat. The spring 26 of course is weaker than the valve spring 5. The spring 26 will tend to swing the arms 14 and 22 toward each other and this movement will cause the cover 20 to tend to rotate with respect to the head 11. This rotative movement will cause the balls 19 to lift the cover with respect to the head until the top of the cover contacts with the bottom of the valve stem. The fingers 17 permit a vertical movement between the head and the cover but prevent the balls 19 from rolling out of the depressions 18 and 20.

The tappet will automatically take care of wear between the top of the cover 12 and the bottom of the valve stem 3. This wear can amount to as much as thirty thousandths of an inch and then the tappet can be adjusted to move it closer to the valve stem. Under normal operations it requires a time period of two or three years to cause wear amounting to about thirty thousandths of an inch.

When the valve is seated, the balls 19 will be in the position shown in Figure 3 and the cover 12 will be at its greatest distance from the head 11. When now the cam C raises the valve lifter D to raise the valve head off of its seat 1, as shown in Figure 4, the pressure of the spring 5 on the valve stem 3 will cause the latter to hold the cover 12 against vertical movement until the cover has rotated with respect to the head 11 after bringing the balls 19 to the centers of the spherical depressions 18 and 20. Figure 4 shows this arrangement. The rotating of the cover 12 with respect to the head 11 will swing the arm 14 away from the arm 22. This position of the two arms will be maintained until the cam C permits the valve

head 4 to be seated and then should the valve lifter D move downwardly still further, the coil spring 26 will instantly come into play and will rotate the cover 12 for causing the cover to remain in continuous contact with the valve stem. There will always be a metal contact between the valve stem and the tappet and this will obviate any possibility of a tappet noise being created by the operation of the engine.

The spherical recesses 18 and 20 create a cushioning effect because the walls of the recesses act on the balls 19 like cams. It is possible to have the recesses 18 and 20 in the shape of cones or other cam-like surfaces rather than the spherical depressions.

In Figure 1 I show a forced feed lubrication system for the valve tappet. An oil pipe 27 conveys oil under pressure to a passage 28 and the passage in turn communicates with an annular passage 29 formed in the outer surface of the valve lifter D. A bore 30 conveys the lubricant from the passage 29 to the recess 8. The shank 9 has a central bore 31 that conveys the lubricant into the space between the cover 12 and the head 11. The cover 12 has an opening 32 communicating with the space and a film of oil will overlie the top of the cover 12 at all times, this film being fed by oil passing through the opening 32. A film of oil will therefore be provided between the bottom of the valve stem 3 and the top of the cover 12 for lubricating the parts.

In Figure 8 I show a slightly modified form of lubricating means for the tappet. Here the reservoir 8a in the valve lifter D is filled with grease. When it is desired to force grease into the space between the cover 12 and the head 11, the lock nut 10 is loosened and the shank 9 is screwed down into the reservoir a slight distance to force a sufficient quantity of grease from the reservoir into the space between the cover 12 and the head 11. The shank 9 is then rotated back to its former position and is secured in place by the lock nut 10.

In Figures 5, 6 and 7 I show a modified form of the silent tappet. In this form the top of the threaded shank 9a has a head 33 with a top 34 provided with a plurality of radially extending grooves 35. The grooves take the place of the spherical depressions 18 in the disc 11. Balls 36 are held against outward movement by a ring or sleeve 37. This sleeve encloses the peripheral portion of the head 33 and bears against a flange 38. Figure 5 shows the inner ends of the grooves 35 provided with shoulders to prevent the movement of the balls 36 inwardly toward the center of the head beyond predetermined points.

A cover 39 takes the place of the cover 12 and has a disc-like projection 40 that is receivable within the top of the sleeve 37, see Figure 6. The cover 39 has a plurality of radially extending grooves 41 similar to the grooves 35 and of equal number. The opposed pairs of grooves 35 and 41 receive the balls 36. Figure 6 shows the cover 39 rotated with respect to the head 33 so that the balls 36 will be disposed at the portions of the grooves 35 and 41 lying nearest to the tops of the grooves.

Again referring to Figures 5 and 6, it will be noted that a coil spring 42 has an end 43 passed through an opening 44 provided in a flange 45 that is integral with the cover 39. The spring 42 has a portion 46 extending from the end 43 and passing through an opening 47 in the flange 38 that registers with the opening 44. The spring 42 then has an arcuate portion 48 that extends through substantially 180 degrees and then the

spring has another portion 49 bent to parallel the portion 46 and to be substantially diametrically opposed thereto. The spring has a second arcuate portion 50 that is disposed above the flange 45 of the cover 39. The cover has a projection 51 which is circular in shape and lies within the arcuate portion 50 of the spring. The opposite end 52 of the spring is secured to an opening 53 which is preferably disposed near the opening 44.

The spring 42 performs a dual function. In the first place the spring holds the cover 39 on the head 33 while permitting a slight longitudinal movement between the parts. In the second place the spring has a torsional effect and tends to rotate the cover 39 with respect to the head 33 so that the balls 36 will ride up on the arcuate surfaces of the grooves 35 and 41. The device when placed in the valve lifter D, and with the cam C disposed at the low point, will have the balls 36 in a position to force the cover 39 away from the head 33 to take up any slack between the end of the valve stem and the tappet. When the cam C lifts the valve head 4 into raised position, the spring 42 will yield to permit the balls 36 to roll to the lowest position in the grooves 35 and 41 and this position is shown in Figure 7. There is no tappet sound when this movement occurs, because the balls will ride over arcuate surfaces in the grooves. The top of the projection 55 will contact with the lower end of the valve stem 3 at all times.

The shank 9^a has a bore 54 extending longitudinally therethrough and disposed at the axis of the shank for carrying a lubricant to the space between the head 33 and cover 39. The cover 39 has a central opening 55 for conveying lubricant to the top of the projection 51. A film of lubricant will therefore be formed between the projection 51 and the bottom of the valve stem.

Although I have shown the device placed between the valve lifter and the lower end of the valve stem, it is obvious that the device can operate in connection with an overhead valve as well. The device can be placed between a rocker arm and the top of the valve stem in an overhead valve or it can be placed at the top of a push rod.

The grooves 35 and 41 may be made with a milling tool. After the grooves 35 are made, the sleeve 37 is slipped over the head so as to retain the balls 36 and rotatably receive the cover 39.

In Figures 4 and 7 I show the balls 19 and 36 large enough in diameter to cause them to space the under surfaces of the covers 12 and 39 above the tops of the heads 11 and 33, respectively, when the balls are disposed at the bottoms of the recess. This means that the balls will transmit the force required to lift the valve 4 above its seat 1. It is possible to make the balls small enough in diameter so that when they are received at the bottoms of the recesses, the covers 12 and 39 will contact the heads 11 and 33. In fact a slight clearance between the tops of the balls and the uppermost portions of the recesses 20 and 41 can be provided so that the balls will not carry any weight when the heads 11 and 33 are moved upwardly for lifting the valve head off from the valve seat. There might be a clearance of .001" or .002" for example, between the tops of the balls and the highest points in the upper recesses. A film of oil will lie between the undersides of the covers 12 and 39 and the tops of the heads 11 and 33, respectively.

As the heads 11 and 33 are moved upwardly against the under surfaces of the covers 12 and 39, the covers will rotate with respect to the heads so that they will come into contact with

each other in a spiral movement rather than in a direct longitudinal movement. This spiral movement can be changed in pitch by shaping the recesses so that no sound of metal contacting with metal will be heard when the heads are moved against the covers. The film of oil between the covers and heads will lubricate the surfaces to a point where they will be practically friction free. In this way the tappet is really silent in operation and guards against any noise being produced when the two surfaces are brought into contact with each other.

I wish the present invention to be broad enough in scope to cover the point of the balls spacing the covers and heads slightly from each other when the balls are disposed at the bottoms of their recesses as shown in Figures 4 and 7 and to also cover the complete contacting of the covers with the heads when the balls are received at the bottoms of the recesses so that the balls will not bear any of the weight when the valve is lifted.

In Figure 10 I show the device placed between the top of a valve stem 60 and a rocker arm 61. The device has a head 62 similar to the head 11 shown in Figure 9, and placed directly on the top of the valve stem so as to be carried thereby. The head 62 has a cover 63 of the same construction as the cover 12. Spherical balls 64 are received in spherical recesses 65 formed in the top of the head 62 and are also received in spherical recesses 66 formed in the under surface of the cover 63.

The cover has an arm 67 that is connected thereto in the same manner as the arm 14 is connected to the cover 12. A second arm 68 is secured to the valve stem 60 so as to project radially therefrom and a spring 69 interconnects the free ends of the two arms so as to yieldingly urge them toward each other.

The rocker 61 is mounted on a rocker shaft 70 and one end 71 of the arm is rounded and contacts with the top of the cover 63. The other end of the rocker arm carries the usual adjustment screw 72 and a lock nut 73. The adjustment screw has a spherical head 74 that is rockably received in a spherical recess 75 formed in the top of a push rod 76.

This form of the device is for use on overhead valves in internal combustion engines and is to take up any play between the top of the valve stem 60 and the end 71 of the rocker arm after the valve spring 77 has returned the valve to closed position. The spring 69 will act on the arms 67 and 68 to tend to rotate the cover 63 with respect to the head 62, so that the balls 64 will lift the cover above the head so as to contact with the rocker arm end 71 at all times. As soon as the rocker arm 61 starts to move the valve stem 60, the initial movement will move the cover 63 toward the head 62 until the two parts contact with each other, whereupon further swinging movement of the rocker arm will open the valve. The device operates in the same way as that shown in the form of the device shown in Figures 1 and 5.

Another modified form of the invention is set forth in Figure 11. Here the silent tappet is placed between the push rod 76 and the rocker arm 61. The head 78 of the silent tappet is carried by the push rod 76 and rotatably supports a cover 79 that is similar to the cover 63, and has a spherical top portion 80 that is rockably received in a spherical recess 81 formed in the rocker arm 61. The cover 79 has an arm 82 similar to the arm 67 and the head 78 has a lower portion 83 that carries a second arm 84 which projects radially from the axis of the push rod 76.

A coil spring 85 interconnects the two arms. The balls and spherical recesses provided between the cover 79 and the head 78 are the same as that shown in Figure 10 and therefore like reference numerals will be applied to similar parts. At the other end 71 of the rocker arm the curved portion of this end contacts directly with the top of the valve stem 60 in the usual manner. The valve spring 77 tends to keep the valve seated at all times.

The operation of this form of the invention is substantially the same as that shown in Figure 10. The spring 85 will swing the arms 82 and 84 toward each other for lifting the cover 79 above the head 78 and keeping the spherical portion 80 seated in the spherical recess 81 at all times. When the push rod 76 is actuated for opening the valve 60, the initial movement will roll the balls 64 to the centers of the recesses 65 and 66 and this will permit the cover 79 to contact with the head 78. Further upward movement of the push rod 76 will now rock the rocker arm 61 and open the valve. There will be no mechanical sound between the metallic surfaces during the opening of the valve because the spherical portion 80 will be held in contact with the wall of the spherical recess 81 continuously.

In Figure 9, I show how the cover 12 can contact with the head 11 during the lifting of the valve stem B by the tappet. The balls 19 in this instance are slightly less in diameter than the combined heights of the superimposed recesses 18 and 20. The forms of the devices shown in Figures 1 to 8, inclusive, can operate in this manner if desired. The structural feature of having the head and cover contact with one another, and thus free the balls from carrying the thrust during the unseating of the valve, will be covered in my copending application, Serial No. 677,552, filed June 18, 1946, entitled "Mechanical silent tappet."

I claim:

1. The combination with a cam-actuated valve lifter, a valve stem, and a valve spring, of a silent tappet carried by the lifter and having a circular head with cam-shaped recesses therein, balls rollably received in the recesses, a member rotatably enclosing the circular head and having cam-shaped recesses registering with said first-named recesses and receiving the tops of the balls, radially extending arms fixed to the head and member, respectively, the outer ends of the arms being normally spaced from each other, spring means interconnecting the free ends of the arms for rotating the member on the head for causing the balls to roll to the more shallow portions of the recesses and move the member into contact with the valve stem end, said spring means yielding when the valve lifter moves to lift the valve and permitting the balls to roll to the bottoms of the recesses so that the balls will carry the thrust of the valve lifter during the lifting movement.

2. The combination with a cam-actuated valve lifter, a valve stem, and a valve spring, of a silent tappet carried by the lifter and having a circular head with cam-shaped recesses therein, balls rollably received in the recesses, a member rotatably enclosing the circular head and having cam-shaped recesses registering with the said first-named recesses and receiving the tops of the balls, spring means for rotating the member on the head for causing the balls to roll to the more shallow portions of the recesses and move the member into contact with the valve stem end, said spring means yielding when the valve lifter

moves to lift the valve and permitting the balls to roll to the bottoms of the recesses so that the balls will carry the thrust of the valve lifter during the lifting movement, said spring means including an arm operatively connected to the head, a second arm swung by the member, and a spring interconnecting the arms.

3. A silent tappet comprising a shank with a circular head having spherical recesses in its top and arranged around the center of the head, a cover having a circular flange rotatably receiving the head and having spherical recesses registering with the first-named recesses, balls rollably mounted in the recesses and being of a size to space the cover a slight distance from the head when the balls are disposed at the bottoms of the recesses, the recesses being of a size to cause the balls to tend to roll to the tops of the recesses when the cover is rotated with respect to the head, and spring means disposed exterior of the head and cover for rotating the cover on the head for causing the balls to move the cover away from the head.

4. A silent tappet comprising a shank with a circular head having spherical recesses in its top and arranged around the center of the head, a cover having a circular flange rotatably receiving the head and having spherical recesses registering with the first-named recesses, balls rollably mounted in the recesses and being of a size to space the cover a slight distance from the head when the balls are disposed at the bottoms of the recesses, the recesses being of a size to cause the balls to tend to roll to the tops of the recesses when the cover is rotated with respect to the head, and spring means for rotating the cover on the head for causing the balls to move the cover away from the head, said flange carrying means engageable with the head for limiting the movement of the cover away from the head so that the balls will always be received in the recesses.

5. A silent tappet comprising a shank with a circular head having spherical recesses in its top and arranged around the center of the head, a cover having a circular flange rotatably receiving the head and having spherical recesses registering with the first-named recesses, balls rollably mounted in the recesses, the recesses being of a size to cause the balls to tend to roll to the tops of the recesses when the cover is rotated with respect to the head, spring means for rotating the cover on the head for causing the balls to move the cover away from the head, said spring means including an arm having a ring-shaped end rotatably mounted on the shank and bearing against the underside of the head, said flange having a recess for receiving the arm so that a swinging of the arm will rotate the cover on the head, said flange also having fingers for holding the ring-shaped arm end in place and for limiting the movement of the cover away from the head, a second arm rigidly secured to the shank and projecting radially therefrom, and a coil spring interconnecting the arms for urging them toward each other for tending to rotate the cover for rolling the balls up the spherical inclines of the recesses for moving the cover away from the head.

6. A silent tappet comprising a shank with a circular head having spherical recesses in its top and arranged around the center of the head, a cover having a circular flange rotatably receiving the head and having spherical recesses registering with the first-named recesses, balls rollably mounted in the recesses, the recesses being of a size to cause the balls to tend to roll to the tops

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of the recesses when the cover is rotated with respect to the head, spring means for rotating the cover on the head for causing the balls to move the cover away from the head, a valve lifter for receiving the shank, said shank having a bore extending through the head, means for delivering a lubricant under pressure to the bore for lubricating the balls, said cover having a bore for permitting the lubricant to flow on top of the cover, said cover being adapted to have its lubricated surface abut a valve stem end.

7. A silent tappet comprising a shank with a circular head having spherical recesses in its top and arranged around the center of the head, a cover having a circular flange rotatably receiving the head and having spherical recesses registering with the first-named recesses, balls rollably mounted in the recesses, the recesses being of a size to cause the balls to tend to roll to the tops of the recesses when the cover is rotated with respect to the head, spring means for rotating the cover on the head for causing the balls to move the cover away from the head, a valve lifter having a reservoir for receiving lubricant, said shank being receivable in the reservoir for closing it, said shank having a central bore communicating with the reservoir and with the space between the head and cover, said shank when moved into the reservoir causing lubricant to be forced through the bore for lubricating the balls.

8. A silent tappet comprising a shank with a circular head and an annular flange, said head having radially extending semi-cylindrical recesses, a cover having a circular portion and an annular flange, the circular portion having radially extending semi-cylindrical recesses registering with said first-named recesses, balls placed in the registering recesses, a sleeve enclosing the head and circular portion, and spring means disposed exterior of the head and cover for main-

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taining the cover in place and connected to the flanges for tending to rotate the cover with respect to the head for causing the balls to roll toward the rims of the recesses for moving the cover away from the head.

9. In a silent tappet; a head having cam grooves therein; balls placed in the grooves and being rollable therein; a cover rotatably mounted on the head and having cam grooves registering with the first-named grooves and receiving exposed portions of the balls; yielding means for rotating the cover on the head for causing the balls to roll up inclines of the cam grooves for moving the cover away from the head; and means for delivering lubricant under pressure between the head and cover for lubricating the balls; and means disposed outwardly beyond the balls for retaining the lubricant against escapement from between the head and cover.

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