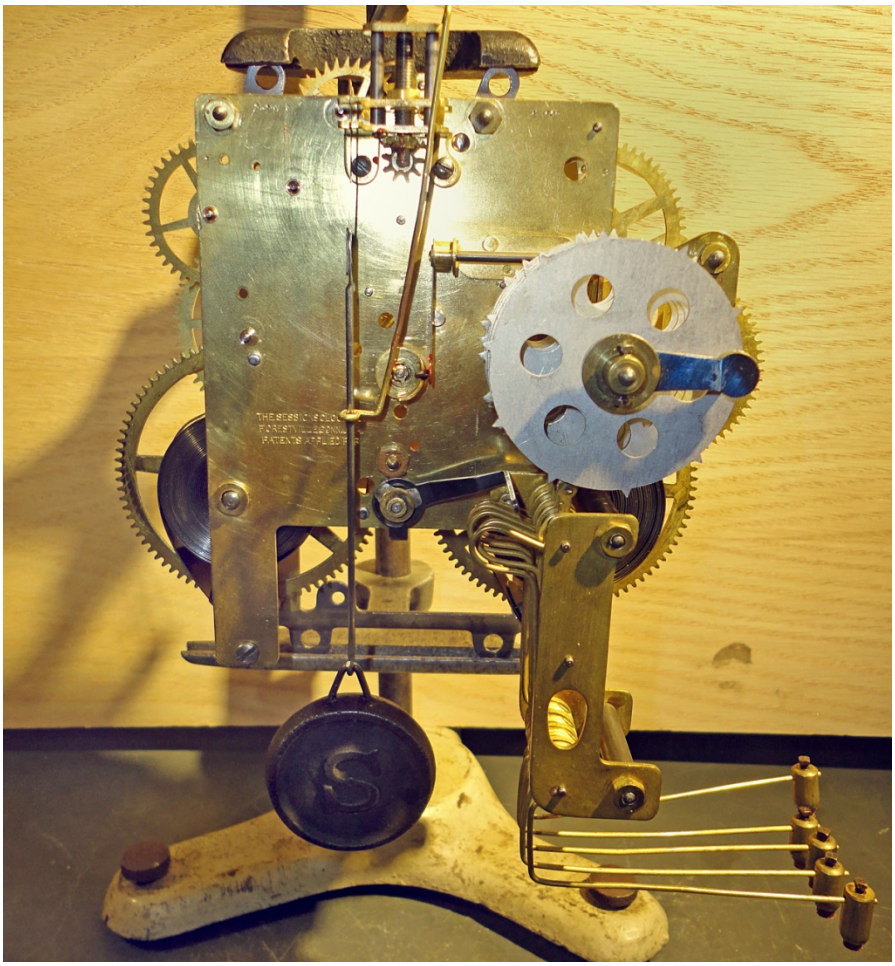
TAMING THE SESSIONS TWO-TRAIN CHIME MOVEMENT



By

Robert H. Croswell

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INTRODUCTION

During the 1930s the Sessions Clock Company, Forestville, Connecticut produced a rather unusual two-train Westminster Chime clock movement with a reputation for being somewhat difficult to troubleshoot and repair. This article will attempt to explain the operation of the patented single-train combined chime/strike mechanism as well as proper procedures for disassembly, reassembly, and adjustment of the movement. It is not intended to be an all-inclusive course in clock repair. The writer assumes that the reader is familiar with basic clock repair procedures such as restraining and letting down main springs, polishing pivots, burnishing pivot holes, installing bushings, adjusting escapements, and the like. These movements often frustrate even experienced clock repair persons but that need not be the case if one follows a few simple procedures and takes time to understand how this amazing little movement operates.

The writer makes no claim of authority or expertise in these matters and will simply relate from experience those methods that have been found to work. The information contained herein is therefore offered completely without any guarantee of accuracy or truth of any kind expressed or implied. Those who choose to rely on the information contained in this article shall do so at their own risk.

GENERAL DESCRIPTION

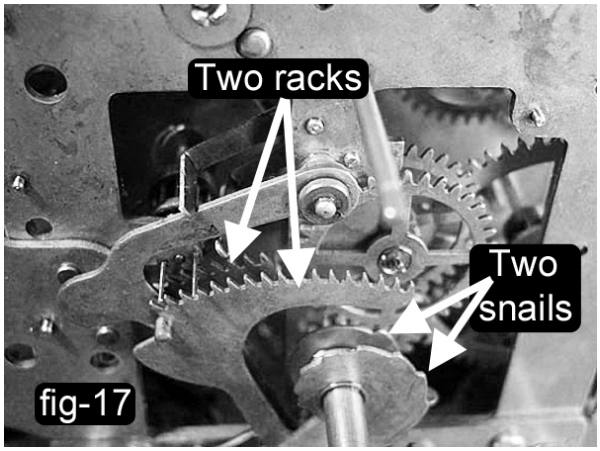
The Sessions two-train chime movement is based on designs described in US patents No. 1,837,462 filed May 10, 1926 (Issued December 22, 1931) and 1,883,387 filed April 18, 1930 (Issued October 18, 1932) to inventor Samuel Mazur of Bristol, Connecticut, assignor to the Sessions Clock Company, or Forestville Connecticut. The 1932 patented movement was very popular and can be found in a variety of shelf clocks by Sessions.


fig-15

The Sessions chime clocks looked almost identical to their Bim-Bam striking clocks on the outside being only slightly larger and having only one small additional opening in the dial just below the center shaft where the small end of the winding key is inserted to activate or deactivate the chiming function (fig-15). Absent is the third winding arbor used by almost all other Westminster chime clocks. These are true chiming clocks that play the Westminster chime

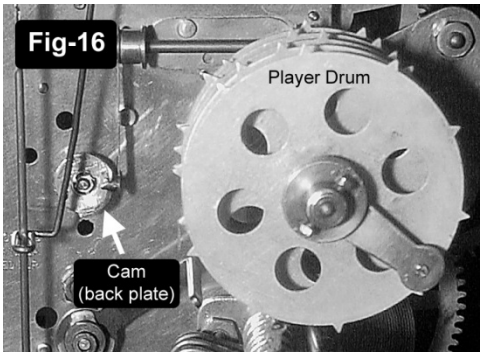
sequences on the quarter hours and strike the hour count on the hour. The unique design combines the chiming and striking functions in one train powered by a single main spring. (*Striking* is the sounding of the hour count at the top of the hour and *chiming* is the playing of a musical sequence of notes on each quarter hour.) A complete and very detailed description of the movement is included in the patent descriptions at the end of this article.

Between the movement plates these movements are very similar to other Sessions non-chime (strike only) movements. The going (time) train is controlled by a basic recoil escapement with the strip pallets or verge located between the plates. The between the plates parts of the strike/chime train should also look familiar and include the usual levers and pins generally associated with other clocks. A closer look reveals that the usual strike control or "maintenance" cam is replaced with a locking plate with two narrow slots used by the locking lever to stop the train when striking and chiming is complete. (fig-1 page 14) Some newer models have one side of the slot slanted producing a larger mouth.



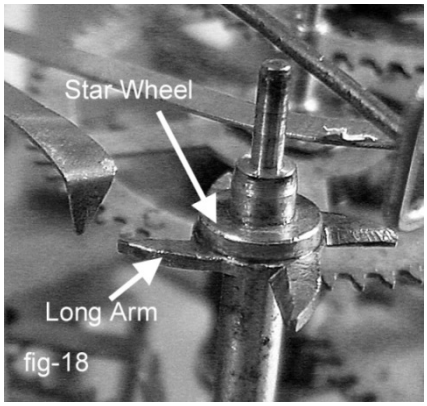
Outside the plates is an entirely different story. Looking at the front of the movement one will notice that this is a rack and snail strike train but it has TWO racks and TWO snails (fig-17 right). A look at the back of the movement reveals a small cam in the middle of the plate and a large "player drum" or pin drum (fig-16 below). The two racks working together with the little cam and the player drum, which can shift outward to play chimes or inward to strike the hour, is what makes it all work. The chime sequence is self-synchronizing and with so few working parts, once setup correctly this can be a relatively trouble free movement.

HOW IT WORKS – THE BASICS



There are four key parts that control the combined chime/strike functions of this movement: 1. the four-arm star wheel attached to the center or minute hand shaft between the plates (fig-18 page 8), 2. The twin racks and snails on the front of the movement (fig-17 above), 3. A small cam attached to the end of the center shaft on the outside of the back plate (fig 16 left), and 4. The five-disk "player drum" which may also be referred to as the *tappet drum* or *pin drum* (Fig-16 left).

The star wheel has three equal length arms plus one arm that is slightly longer. The star is pressed firmly onto the center shaft and normally should not be removed during service as its



position is critical to the clock chiming and striking exactly on the quarters of the hour (fig-18 left). On the 1st, 2nd, and 3rd quarter one of the short arms lifts a control lever which raises the rack hook or rack detent lever just far enough to release the smaller auxiliary or "chime rack". The small auxiliary or chime snail positions this rack to have 1, 2, or 3 teeth gathered when the chime sequence begins at the "3", "6", or "9" position. This will allow the player drum to advance 1, 2, or 3 positions. Each position of the player drum will play 4 notes while the clock is in chiming mode. Therefore at 9 o'clock three teeth are gathered causing the player drum to advance 3 positions sounding a total of 12 notes, and so on.

On the hour the long arm of the star lifts the control lever a little more causing the rack hook lever to release BOTH racks. The auxiliary or chime rack will be positioned to have four teeth gathered while the larger hour rack will be positioned to have one tooth gathered for each hour to be struck. That is, if the time is 6 o'clock the axillary or chime rack will count 4 teeth and the hour rack will count 6 teeth for a total of 10 teeth to be gathered which will cause the player drum to advance 10 positions**. It is critical that one understand that neither rack directly controls the chime function, and neither rack directly controls the strike count on the hour.** The tooth counts from both racks are added together to determine the total number of positions that the player drum will advance.

The player drum consists of four metal disks permanently joined together to the wheel hub plus one disk that is free to rotate alone (fig-5 page 20). The player drum assembly is held toward the back of the movement by a spring under the drive arm. At the top of the hour the four inner disks lock on a post under the drum ending the chime sequence. In this position, only the outer disk may turn. This is the "strike" position and each time the wheel advances one count a tappet on the outer disk raises and drops the strike hammer one time, repeating until the hour count has been struck.

During the first part of the first quarter hour, as the minute hand advances from "12" toward "3" the small cam on the back of the movement moves a forked lever that shifts the player drum outward raising it off of its locking pin and engaging the drive pin in the drive arm. In this position all five disks rotate together. This is the "chime" position and each time the drum advances one position 4 tappets will lift and drop 4 hammers to play 4 notes of the chime sequence. That is, if it is the 3rd quarter hour the drum will advance 3 positions (one for each quarter hour as set by the auxiliary rack) to play a total of 12 notes. If it is the 4th quarter (12:00) the drum will advance 4 positions to play 16 notes. It should be noted that with the player drum in the chiming (shifted out) position, the tappets of the 5th disk bypass the short pin in the 5th hammer actuating lever.

On the hour the player drum will advance 4 positions plus the number of positions corresponding to the hour to be struck. The player drum will advance 4 positions playing 16

notes (4 notes for each position) at which point the player drum will have rotated 360 degrees and the locking hole on the back side of the innermost disk will again be over be over the locking pin. The small spring under the drive arm will move the player drum toward the rear plate and onto the locking pin simultaneously disengaging the inner 4 disks from the drive pin. This shifts the player drum from chime mode to strike mode. The outer disk continues to advance a number of positions corresponding to the remaining count which is the hour count. In this position the tappets of the 5^{th} disk are lined up to engage the short pin of the 5^{th} hammer actuating lever thus striking the hour count on the 5^{th} tone rod while the other 4 hammers remain at rest. The whole process repeats on the next hour.

Because the player drum will always lock when the locking hole comes over the locking pin and stay locked until moved off of the pin by the cam during the first quarter, the chimes are self-synchronizing on the next hour.

A STRIKING EXAMPLE – the 7:00 o'clock strike

Our clock has just finished striking 6 o'clock and the minute hand is straight up on numeral 12. The cam follower is just about to begin its assent up the slope of the cam on the back of the movement (fig-14 page 16). The player drum is seated on its locking pin with the inner four disks disengaged from the drive arm pin. This should always be the case at the start of the hour.

The minute hand advances from "12" toward "3" and at about "2" the cam follower is pretty well up the slope of the cam and player drum has moved off of its locking pin and is now engaging the drive pin of the drive arm.

The minute hand advances from "2" to "3" and the auxiliary or chime rack is released for a "1" count (1 tooth to be gathered from the rack) for 1 quarter past the hour. The chime/strike train is unlocked and the player drum advances one position playing 4 notes (one note from each of the four rotating chime disks) for the 1^{st} quarter chime sequence. The player drum has rotated a total of 1 position so far this hour.

The minute hand advances from "3" to "4" and the cam follower drops off of the cam high point at about this position but the exact point is not important. Nothing noticeable happens but the player drum shifting lever is no longer in contact with the player drum which is now riding on the end of the locking pin until the locking hole again comes into position. If one listens carefully one may hear the cam follower drop at about twenty minutes after the hour.

The minute hand advances from "4" to "6". The auxiliary or chime rack is released for a "2" count. The chime/strike train is unlocked and the player drum advances two positions playing 8 notes for the 2^{nd} quarter chime. The player drum has now rotated a total of 3 positions so far this hour.

The minute hand advances from “6” to “9”. The auxiliary or chime rack is released for a “3” count. The chime/strike train is unlocked and the player drum advances three positions playing 12 notes for the 3rd quarter chime. The player drum has now rotated a total of 6 positions this hour.

The minute hand advances from “9” to “12” (the hour hand is now on the “7”). The auxiliary or chime rack is released for a “4” count corresponding to the 4-position advance of the player drum required to play the final 16 note chime sequence on the hour, **AND** the larger hour rack is also released for a “7” count corresponding to the 7-position advance of the outer strike disk to strike seven times for the 7 o’clock hour count.

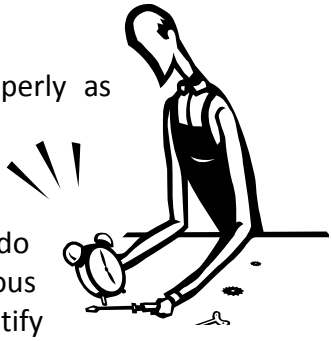
This is where it gets a bit tricky to understand. We now have a “4” count *registered* on the small ancillary chime rack, and a “7” count *registered* on the larger hour strike rack for a total of 11 (eleven) rack teeth to be gathered. As each tooth is gathered the player drum will advance one position. The clock has to chime first and then strike 7 (seven) times and stop. Note that **the larger “strike rack” is always gathered first** and the smaller auxiliary chime rack is gathered last so how can the clock possibly chime before it strikes if the strike rack is gathered before the chime rack? It’s really quite simple.

Up to this point we have referred to the small rack as the “chime rack” because it registers the number of positions the player drum must move to chime, and the larger rack as the “strike rack” because it registers the number of positions the strike disk of the player drum must move to strike the hour count. That’s really a bit of a misnomer because neither rack has exclusive control of chiming or striking. Each rack (*register*) contributes to the total number of positions the chime/strike drum needs to advance complete the hour chimes and strike count. This is how it happens.

The chime/strike train is unlocked and 4 teeth are gathered from the larger rack. The player drum advances four positions playing 16 notes for the 4th quarter hour chime at which time the player drum has now rotated a total of 10 positions or 360 degrees so its locking hole is now in position over the locking pin. The spring under the drive arm moves the 4-disk player drum onto the locking pin disengaging it from the drive pin leaving only the outer strike disk to rotate. Note that there are still 3 (three) more teeth to be gathered from the large rack and these are now gathered and the strike disk advances 3 (three) positions and the clock strikes 3 (three) times. The large rack is now completely gathered and drops down allowing the rack hook to engage the smaller rack. There are 4 (four) teeth to be gathered from the small rack so the strike disk advances an additional 4 (four) positions striking 4 (four) more times for a total of 7 (seven) strikes at 7:00 o’clock. When both racks have been gathered the chime/strike train locks until the next quarter hour.

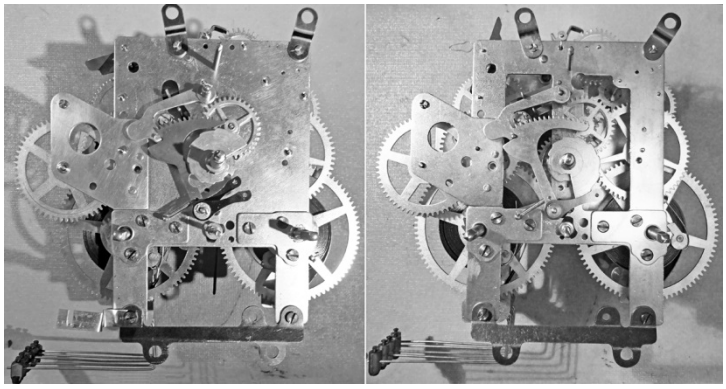
This will become clearer as one studies the section below on reassembling and adjusting the movement. One beauty of this movement is that if one follows the setup and adjustment procedures described below, one really does not need to understand *how* it all works – it just does! It is a fascinating movement to watch.

SERVICING THE MOVEMENT



Don't assume that the clock is assembled or adjusted properly as received. If the clock is not working properly, there is a good possibility that someone has tried to fix it and given up, leaving it improperly assembled or improperly adjusted. Before servicing this, or any movement with which the repairer is not familiar, one would do well to take pictures of the movement from all angles and at various stages of disassemble. If possible the repairer should attempt to identify any defect or the cause of any malfunction before disassembly. One might want to read the section on reassembling and adjusting the movement to better visualize what the trouble may be.

These movements have soft pivots and are known for frequently requiring pivot and bushing work. The second wheel pivots are heavily loaded and usually require attention. In the worst cases it may be necessary to replace badly worn pivots. When bushing the second wheel pivot holes one might want to install a bushing with no oil sink to better support the pivot. Installing a bushing with an oil where no oil sink existed before will reduce the contact area for the pivot and shorten pivot and bushing life. If the clock is exhibiting chime/strike problems, one should carefully inspect for a worn pivot hole at the gathering pallets arbor. A sloppy hole can cause misalignment of the gathering pallets and the rack teeth. Repairers often leave the gathering pallets in place as this part can be difficult to remove, however in doing so, a rough pivot or worn pivot hole often goes un detected and un repaired.



During production Sessions made a number of changes, some of which may be unknown to this writer. Some of these are described here and in the sections on disassemble and assembly. One of the most noticeable differences is in the front plate. Some movements had a mostly solid front plate (fig-19 left) while others had a more traditional cut out front plate (fig-19 left). The cut out front plate allows greater visibility but has less rigidity. One must use care when removing the gathering pallets from the open plat movement to avoid bending the plate.

This writer has found conflicting information regarding the correct size main springs for these movements. It is unclear if Sessions changed the spring size during the years these movements were in production. It is interesting to note that some (later?) movements have the main wheel arbors fitted with a brass sleeve thus increasing the

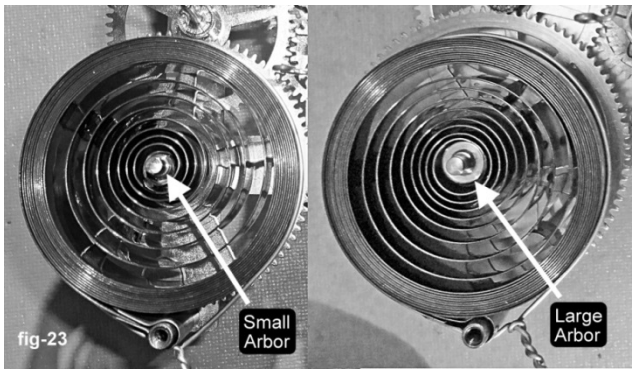


fig-23

effective diameter of the arbor and enlarging the diameter of the inner spring coil. Others have a more traditional small steel arbor. The reason for this change is unclear but the larger center arbor should put less stress on the inner coils of the spring while applying the spring's power at a greater radius from the arbor center. The smaller arbors can be upgraded by fabrication a 3/8" brass sleeve and new spring anchor pin. (see fig-23 page 11)

One should not assume that the springs found in a Sessions 2-train movement are original or correct. One clock owner advised me that he found what are believed to be original springs that measured ¾" x 0.020" x 110". Steven G. Conover states in *Chime Clock Repair, Second Edition,* "The time mainspring is a loop-end type which is ¾ inch wide, .018 inch thick, and 96 inches long", and "The chime-strike mainspring is ¾ inch wide, .018 inch thick, and longer than the standard spring at 108 inches". Other sources suggest that ¾" x 0.018" x 96" is the correct replacement for time and chime/strike. This writer has also found springs that are 0.813" wide x 0.165" x approx. 110" long used in the time train. As of this writing www.timesavers.com lists part number 32547 which is ¾" wide x 0.020" thick x 96" long. Loop-end springs 0.018" thick and longer than 96" are difficult to impossible to find. Because both the time and chime springs are called on to power more operations than in other typical American mantel clocks one should avoid replacement springs thinner than 0.018" and/or shorter than 96" long. A time side mainspring 0.018" thick will easily drive this movement in good shape to a healthy pendulum swing, Over-powering the time train may result is excessive pendulum swing that could cause the pendulum bob to strike the chime lever assembly due to the limited space

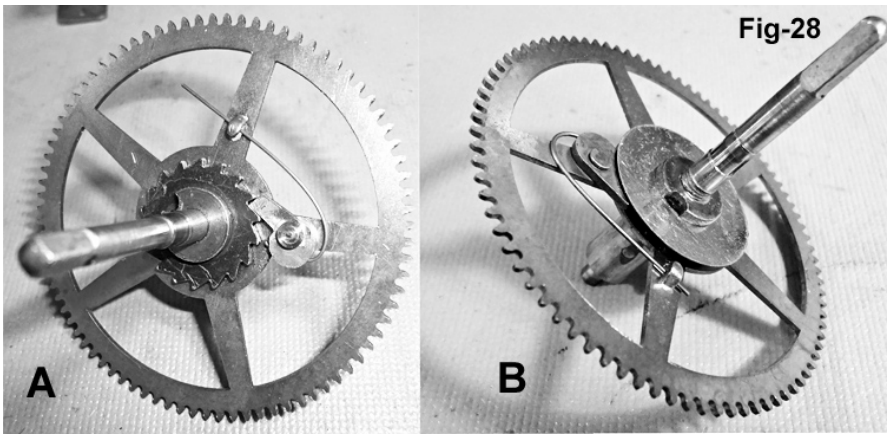


Fig-28

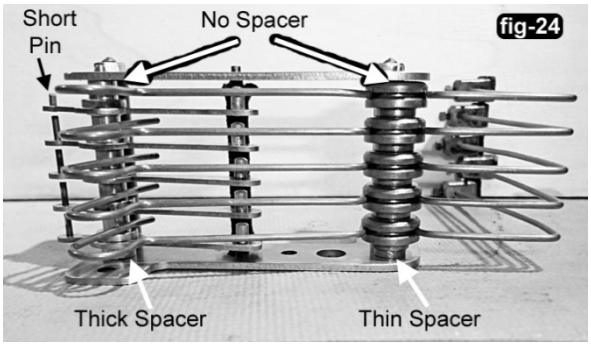
Sessions clocks are also known for frequent click problems (The "click" is the little ratchet dog that keeps the main spring from unwinding and goes click, click, click as the clock is wound). Later production main wheels added a thin metal disk over the click to keep it from slipping off of the ratchet wheel when the small brass rivet becomes worn or loose (Fig-28 B). Replacing the original rivet with a properly fitted steel shoulder rivet with a larger head is recommended. (There is no need to retrofit a click shield disk where none exists). One is advised to carefully inspect both clicks and click rivets and click springs. If the click rivet is loose, the best solution is to remove the click and replace the rivet with a steel shouldered rivet. While the click is removed, a good practice is to replace the brass click spring wire with a comparable steel spring fabricated from a piece of music wire. These parts are commercially available but many repairers prefer to make their own to ensure a proper fit and lasting quality.

Sessions recommends oiling these clocks once a year. Considering the loading on the pivots in the lower trains and the frequency of pivot failure, that seems like good advice but is seldom followed.

DISASSEMBLING THE MOVEMENT

The Sessions two-train chime movements are constructed such that the main springs may be removed without separating the plates. This feature is helpful if one only plans to service the springs or clicks while not disturbing the rest of the movement. The first step in removing the main wheels and springs is to place a spring retainer clip or wire around each spring. Then with the movement secure, use a letdown tool to let down the springs into the restraining clip or tied wire. Once the springs are secure, the bottom pillars can removed (note which end goes to toward the front) and then the front main wheel bushing plates can be removed after which the main wheels and springs can be removed from the movement. Care should be exercised not to bend the plates or wheels. There is no need to remove the main wheels and springs in this manner if the entire movement is to be disassembled, but the springs still need to be restrained and let down before disassembly.

A complete disassembly begins by removing the pendulum, suspension spring, and the rate adjusting device at the top of the movement after which the rate adjusting arbor can be pulled from the movement.

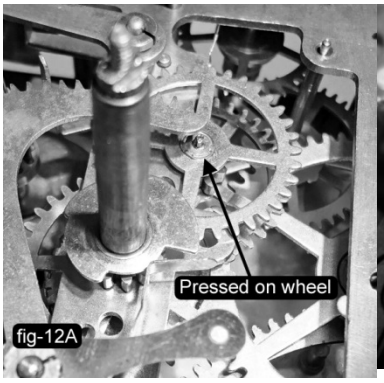


Next remove the two nuts holding the chime hammer assembly and lift it from the movement. Raise the hammers and push the actuating levers aside to clear the player drum. The chime hammer assemble is easily disassembled but one should make note of the order the parts are removed. The outer lever that lifts the strike hammer is different from the other levers and there are two spacers of different thickness. The hammers should be marked so they can be reassembled in the same order.

Loosen the two set screws holding the player drum drive arm and remove the drive arm. Remove the small coil spring from the player drum shaft and remove the player disks. The outer disk comes off alone and the other four disks come off together. (see fig-5 page 20)

From the front of the movement, loosen the set screw(s) in the large hour snail and lift it from the hour pipe. Then lift the small auxiliary snail from the hour pipe. Next unhook the two small rack return springs being careful not to damage them, and then remove the two racks. Depending on which variation one has, there may be a spacer between the racks. Now remove the rack hook lever. Some versions use a split collar to hold the levers in place while others use a flat washer and lock wire. (see figs. 3, & 10 page 18)

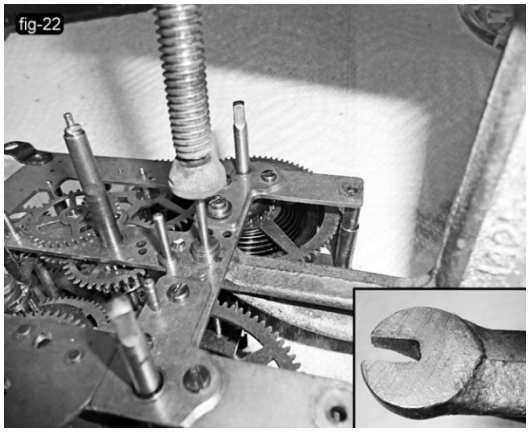
Inspect the wheel (gear) that engages the pinion attached to the auxiliary rack. If this wheel is held with a set screw (fig-12), remove it. If it is pressed on (fig-12A) just leave it in place unless that pivot hole is worn and is to be bushed. A small brass helper spring is shown on the rack hook of the example in fig-12. This is not believed to be a factory installed spring as gravity is usually sufficient to hold the rack hook, however the spring will need to be removed if present during disassembly.



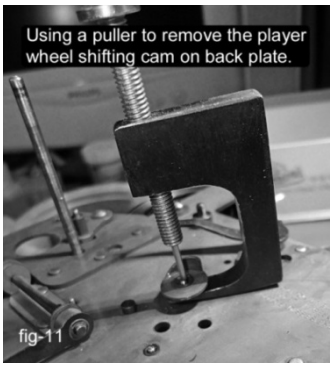
There should be a small brass wire "helper spring" coiled around one of the control lever arbors with the end of the spring wire hooked into a small hole at the top of the front plate (see fig-4 page 18). Unhook this spring wire trying not to bend it any more than necessary as these wires tend to break easily. Many experienced repairers just replace these springs.

The small brass hub supporting the two gathering pallet pins should now be removed being very careful not to bend the arbor on which it is mounted. It is pressed on but should be removable. This pivot hole frequently wears and one must be careful to properly locate the bushing when bushing this pivot hole else the gathering pallets will not properly engage the rack teeth.

There is chime silencing lever on the back plate that is attached to a shaft that passes through the movement and projects from the front plate. This shaft is held by a brass collar which is pressed on. A hollow tip brass punch placed over the end of the shaft and tapped with a hammer while supporting the plate should drive the shaft through the collar and free the assembly. A modified "C" clamp as shown makes the task easy. One variation of the chime silencer uses a tapered pin to hold the brass collar on the shaft (see fig-9 page 22). One might consider such a modification during reassemble if maintaining strict originality is not a concern.



The last thing to remove before separating the plates is the small cam on the end of the center shaft on the back plate. This part is usually pretty tight and a puller will make removal much easier. If the cam is pulled or levered from under the large part of the cam chances are it will be separated from the hub leaving the hub



behind. The center shaft can easily be bent during the removal process; it should be carefully checked before reassembly. There is no need to remove the cam follower arm or the forked lever that shifts the player drum. **Use caution when polishing this pivot not to reduce the diameter where the cam is pressed on or it may slip after reassembly**.

If the main springs have not already been restrained with tie wire or spring clips and let down this should be done now. After the springs are secure, support the movement with the back plate up and remove the four nuts and two screws holding the back plate and gently lift it from the movement trying not to disturb any of the wheels. This is a good point to take a few pictures to help with reassembly.

The rest of the disassembly is straight forward. All the parts should be cleaned, inspected, and any needed pivot and bushing work completed. Be sure to check the pivot holes in the pallet (verge) arbor support arms. The main springs also need to be cleaned. **Do not clean the aluminum alloy player drum in the same solution with other parts!** A severe electrolytic chemical reaction can occur resulting in staining of the brass parts and degradation of the aluminum parts in some cleaning solutions.

REASSEMBLING THE MOVEMENT

If the movement being serviced has main wheels with click shield disks as seen in Fig-28B on page 12, begin by installing the two front plate winding arbor bushing plates and all internal parts, otherwise the bushing plates and the main wheels and springs may be added later. **The click shields (when present) make it very difficult to install the main wheels after assembly of the main plates**.

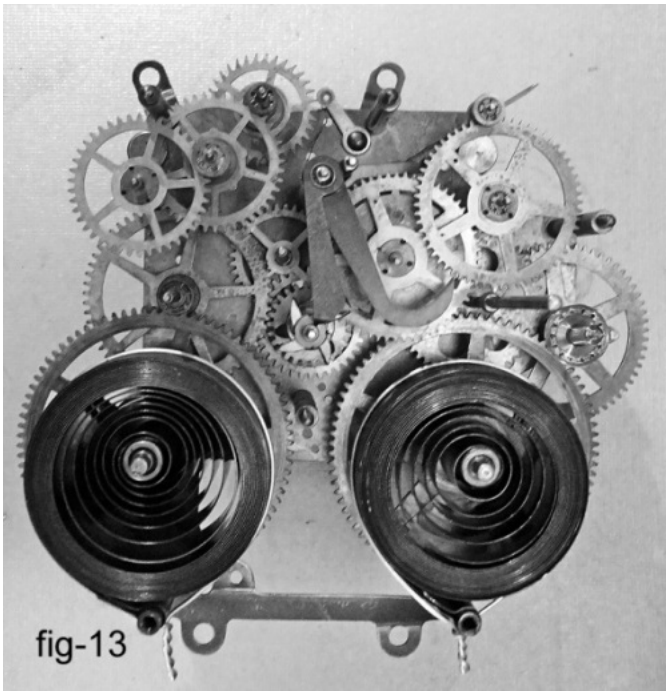


fig-13

Support the front plate and positioning all the between the plate parts as shown in fig-13. Make sure that all the lever arms are where they need to be. With this movement it is easy to get it assembled only to discover that the stop lever is on the wrong side of the stop wheel, or the lifting lever is on the wrong side of the center shaft.

Locate the wheel that has the chime locking plate or cam 5 (the 4th wheel in this movement). Position that wheel so that the locking lever 6 is in one of the two locking slots A or B. Locate the “warning wheel” 2. Position the warning pin 1 on this wheel as shown in fig-1,

approximately at the rim of the 4th wheel 3. The warning run needs to be fairly short to prevent premature hammer lifting during the warning run. Some references show the warning pin straight up but this writer finds the position shown and the shorter warning run makes adjusting the player drum so the first hammer does not begin to rise during the warning run much easier. Note that some versions have slots in the locking plate (sometimes called the maintenance cam) shaped like “A” and others like “B”.

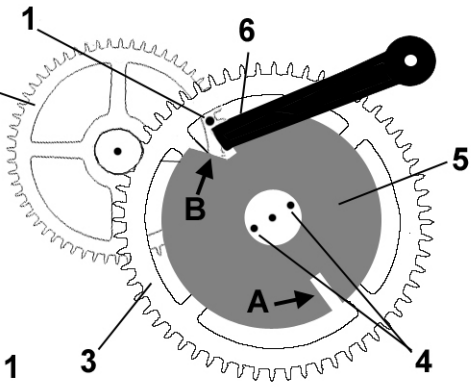


fig. 1

1. warning pin
2. warning (5th) wheel
3. locking wheel
4. gathering pallets
5. locking plate (cam)
   A old style slot
   B new style slot
6. locking lever

(front view)

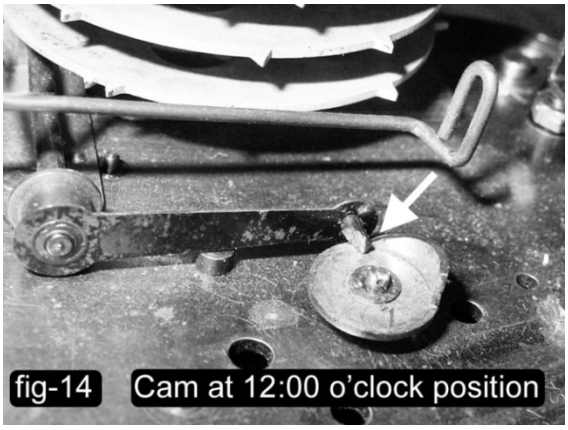
(Note that the warning pin 1 is on the warning wheel 2.)

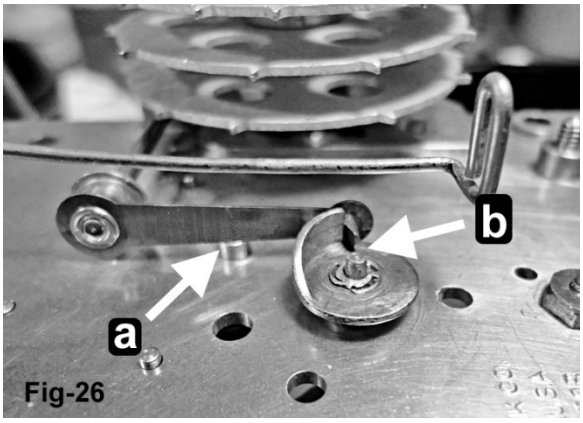
Keeping the locking wheel, locking lever, and warning wheel in this alignment, fit the back plate to the movement lining up the pivots with the pivot holes and bolt the plate in place. Once the plates are bolted together recheck the position of the warning pin with the locking lever in the locking plate. This should give the correct amount of the warning wheel advance during the warning run. The warning run must be enough to ensure that the locking lever is clear of the slot in the locking plate. If the warning run is excessive it may be difficult or impossible to adjust the player drum such that none of the hammers begin to lift during the warning run.

This is a good time to check the action of the escapement using hand power on the going (time) train wheels and make any needed adjustments. Escapement adjustments are very sensitive. Just a small change can make a big difference. One should refer to a good book on escapements or general clock repair methods for the proper procedure for adjusting a recoil strip pallet escapement. If the clock was not chiming and striking exactly on the quarter hours, now would also be a good time to install the minute hand and check that the lifting lever drops off of the star wheel with the hand pointing straight up to the top of the movement. + or – one minute either side of the hour is considered OK by many for a clock of this type. If the clock is off by more than this the problem may be a bent minute hand or the lever following the star wheel may be bent. Unless the star wheel has been previously removed, one should generally not attempt to change its position on the center shaft.

If bushings were installed or other repairs made to the going train, one might opt at this point to install the pendulum support and pendulum (and the main wheels and springs if they were not installed earlier) and place the movement on a test stand for a few days to make sure the time side is running OK before continuing the final strike side assembly and adjustment.

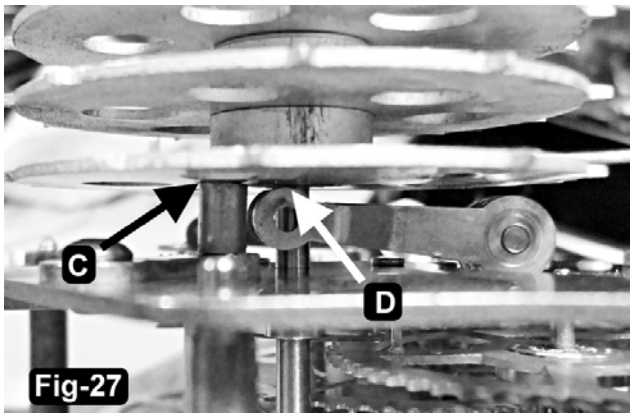
The small player drum shifting cam should now be installed on the end of the center shaft. Before placing the cam on the shaft, temporarily install the minute hand making absolutely sure that when the hand is pointing straight up to the top of the movement and that it is in the 12:00 o'clock position and not the 6:00 o'clock position. **The minute hand needs to be in the 12:00 o'clock position for the rest of the assembly**. Advance the minute hand from the 12:00 o'clock position slowly through all four quarters stopping again at the 12:00 o'clock position. Carefully watch the action of the lifting lever on the front of the movement as the minute hand is advanced around the dial through each quarter hour. The lever will be responding to the longer arm of the star wheel and will lift it a little higher at "12" than at any of the other quarter hours. **It is absolutely essential that the center shaft be in the 12:00 o'clock position before setting the cam and the player drum.**





Once it has been determined that the center shaft is in the 12:00 o'clock position the cam is placed on the end of the center shaft and positioned such that the cam follower is about to start up the slope of the cam. (see fig-14 above) The cam may then be driven (or pressed) onto the shaft using a hollow tube or punch. (The other end of the center shaft, with the minute hand nut in place (to protect the threads), should be placed against a block of wood while the cam is being driven onto the shaft. The cam should be driven onto the shaft until the cam follower arm rests on the stop shown at "a" in fig-26 and just bit more until there is just a slight clearance between the tip of the cam follower and cam at "b" in fig-26. This will ensure that the player drum will shift the correct amount and that the cam follower does not drag on the cam after the drop off point.

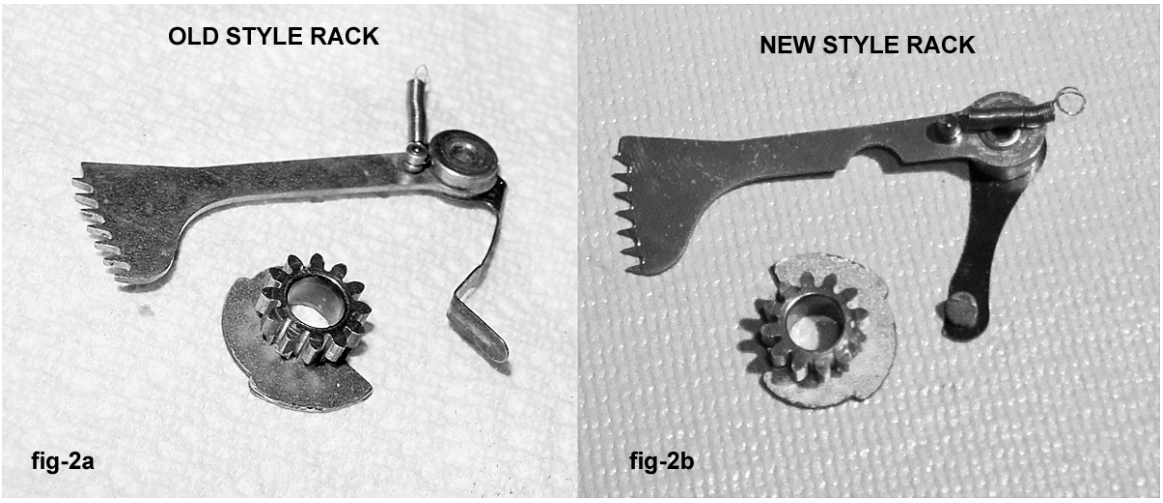
Return the minute hand to the 12:00 o'clock position. Temporarily place the 4-disk chime player drum on its shaft and rotate it while gently pressing it toward the back plate until it slips onto its locking pin. Holding the player drum onto the locking pin check that the player drum is supported only by the locking pin (Fig-27 point "c") and that there is a slight clearance between the lifting forks and the player drum (Fig-27 point "D"). If



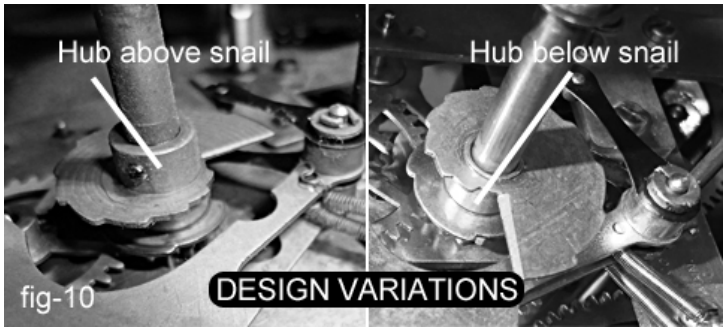
there is more than a slight clearance at "D", or if the player drum is being supported by the lifting forks instead to the locking post at "C", then the position of the lifting forks in relation to the cam follower arm should be adjusted. This can be accomplished by holding the cam follower arm in the jaws of pliers and firmly grasping the lifting forks and twisting them on the arbor one way or the other as required to position the forks just slightly under the player drum as shown in Fig-27 on page 17. Make sure the cam follower is not on the slope of the cam during these adjustments. These adjustments ensure that the player drum will be shifted the proper amount during the changeover from strike mode to chime mode. Set the player drum aside for now.

It is now time to install the parts to the front of the movement. If the driving wheel for the auxiliary cam was removed, replace it now. With the minute hand still in the 12:00 o'clock install the small auxiliary or chime rack and then the larger hour rack making sure to install any spaces that were between them before disassembly. If the racks were secured with brass collars use care not to press the collars on too far and bind the racks. The rack springs should be attached to the racks but may be left off of the anchor post for now. Next rotate the locking wheel until the locking lever is into one of the two slots in the locking disk (fig.-1 page 15). Install the gathering pallets hub positioned such that the two pins are perpendicular to a line between the two slots in the locking disk and tangential to the path of the rack teeth. In other words, when the chime/strike train locks and stops, the gathering pallet pins will be clear of the rack teeth so the racks are clear to drop when released. Unlike many other movements the gathering pallet position is not critical so long as the racks clear the pallet pins when released. Drive the gathering pallets hub onto the shaft using a hollow punch far enough so that the smaller rack's teeth do not contact the brass hub when the rack is released. **Caution, if the 4th. wheel pivot hole on the back plate was bushed the end of the arbor will need to be supported so the bushing will not be driven out as the pallets are driven on!** Carefully attach the two small rack springs. It may be easier to attach one end of the rack return spring to the racks before installing the racks. These springs are often found stretched or with poorly formed ends. The springs **must** still be under some tension when the rack tails are at the lowest part of the snails.

Now place the small auxiliary or chime snail over the hour pipe. Position it so the tail of the auxiliary rack is in contact with the middle of shallowest segment of the snail. At least two styles of auxiliary chime racks were used. The "old style" used a flat metal strip for a tail which is easily bent out of shape (fig-2a below). If after assembly fewer than four teeth or more than four teeth are gathered from this rack on the hour, or if the gathering pallet pin falls on a tooth tip instead of between two teeth, and the movement has the old style rack, the tail may need to be reformed (bent) slightly to correct the problem. Later models apparently used the improved rack with a much more secure tail design (fig-2-b below) and normally require no adjustment.



The large hour snail is installed next but we need to take some special precautions to ensure that it does not bind against the smaller snail under it when the set screw is tightened. When these clocks stop for no apparent reason and seem to have no power to the escape wheel it is frequently because the snails are binding after they rotate a bit. Obtain a piece of fine steel wire or music wire just a few thousandths of an inch thick and shape it into a hairpin shaped clip that will fit close around the hour pipe just above the small snail. Place the large snail on the hour pipe and press it down against the hairpin clip and rotate it such that the hammer tail "peg" is at the shallowest part of the snail a little back from long wall that separates the 12:00 o'clock and 1:00 o'clock segments of the snail (see fig-21 appendix pg. 34). Tighten the set screw in the snail, remove the wire spacer and check that the rack tail falls freely all the way to the lowest part of the snail without actually touching the edge between the 12:00 o'clock and 1:00 o'clock wall. A thin feeler gauge other spacer may be substituted for the "hairpin" spacer. Double check that both snails are correctly positioned and that the minute hand is at 12:00 o'clock. This will ensure that the two snails, which rotate at different speeds, will not bind and stop the clock. The rack hook should now be installed. Most repairers recommend that the rack hook post and the post about which the racks pivot should <u>not</u> be oiled.



It is important that the large hour snail be installed with the correct side up. There are two known variations of the snail. One has the mounting hub and set screw <u>under</u> the snail and the other has the mounting hub and set screw <u>above</u> the snail.

Care should be used to ensure that any and all spacers between the snails be installed correctly so the rack tail pin engages the snail properly. Regardless of whether the hub is above or below the snail, it must be installed so its shape is as shown in fig-10 above.

It should be noted old and new style rack and snail parts, while very similar, are not interchangeable, especially when the snail hub and set screw are below the snail where under some conditions the setscrew can hang on the rack tail. A clock with the old style parts may be updated as long as the racks and snails are all from the newer version.

If the main wheels and springs were not installed during the initial assembly they should be installed now. They may look the same but the chime/strike main springs may be different from the time main spring so make sure the wheels are in the correct position.

The end of the small coiled brass helper spring found on the lifting lever arbor (shaft) should be hooked into the small hole at the top of the front plate (fig-4 right) if present, or over the edge of the plate. Brass spring wire is easy to break so avoid any unnecessary bending. Some repairers recommend replacing these springs with new during a rebuild. Tension the spring just enough to hold the lever in place when the movement is inverted.

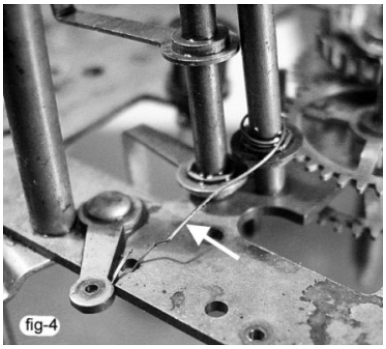
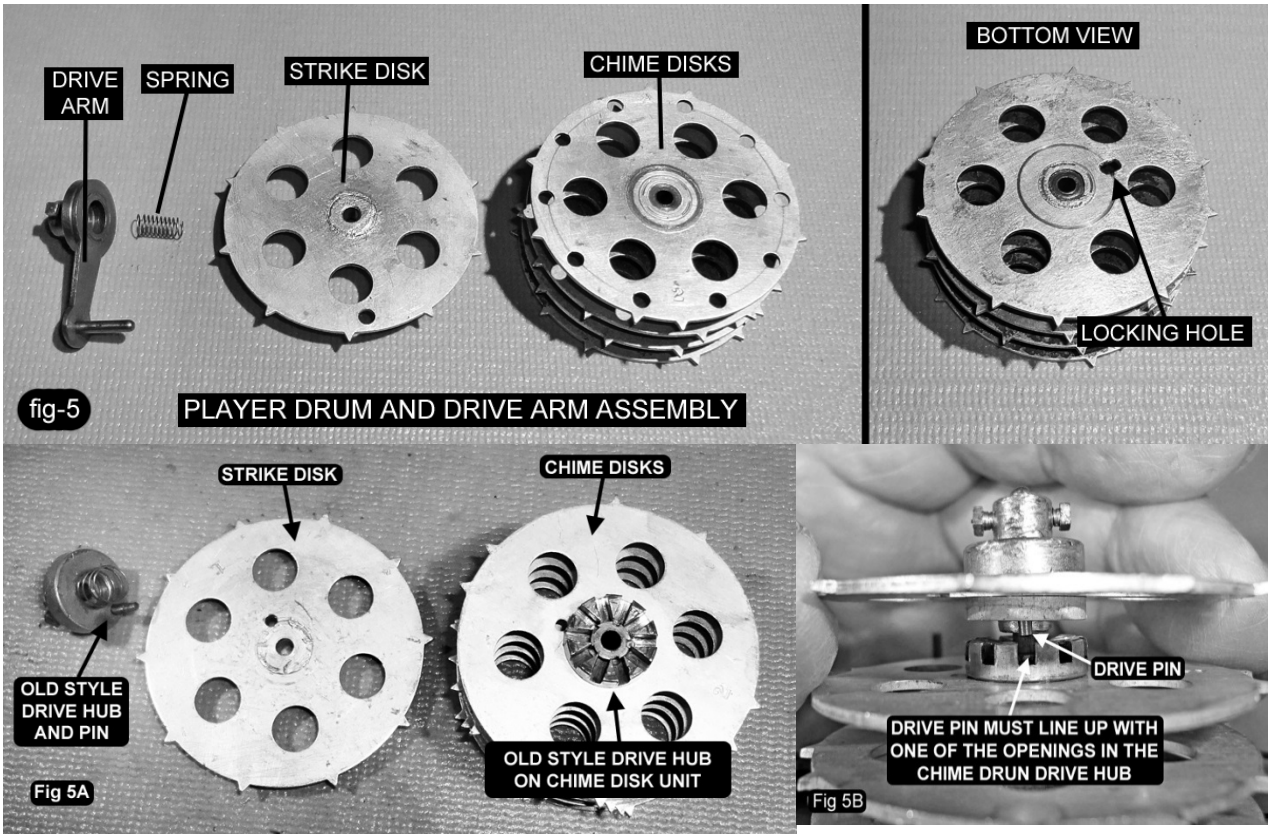


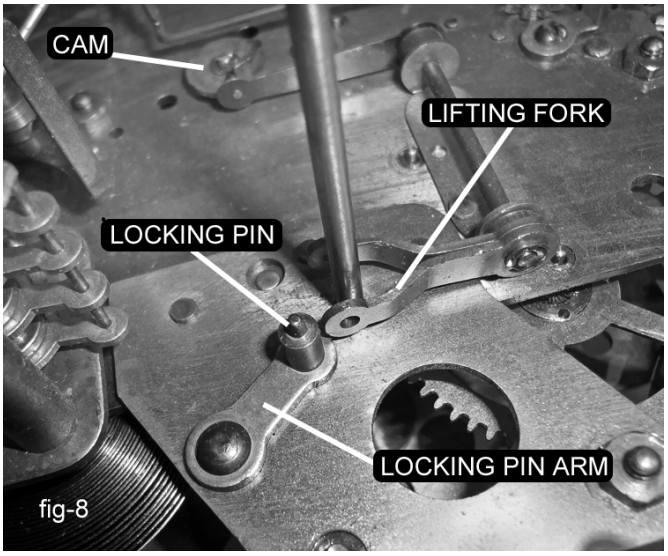
fig-4

Now turn to the back of the movement and install the pendulum suspension/rate adjuster mechanism including the small shaft that passes through the movement and out the front. The actual pendulum suspension spring and rod will be installed later.

The final assembly adjustments require that the hammer assembly now be installed. If this assembly was disassembled for cleaning, reassemble it and mount it to the movement and tighten the two mounting nuts. The mounting holes in the chime unit are frequently found to be larger than the threaded mounting posts. It may be necessary to loosen the mounting nuts and reposition the chime unit slightly for best hammer action. Note that chime hammer and actuating lever pivots should be cleaned but NOT oiled. The viscosity of the oil will slow the fall of the hammers.

Locate the parts of the player drum assembly shown in fig-5 or 5A (page 21). There are two versions of the player drum assembly. Figure 5 shows the more common newer version; figure 5A shows the older style. Some of the later new versions also have the drive pin spring-loaded by a thin leaf-spring. Supposedly this would allow the pin to retract if it isn't exactly lined up with one of the holes in the chime disks, of course the chime/strike sequence would be wrong but the clock wouldn't just go silent and lockup. The old style chime/strike unit has a drive pin mounted in the small brass drive hub. The pin enters the strike disk through a small hole near the center of the strike disk and engages one of the slots in a brass drive hub on the chime disk group. The newer and more common style has a long drive arm attached to the drive hub with a drive pin that engages a small hole near the rim of the strike disk and one of the holes near the rim of the chime disk assembly. Although quite different in appearance, both versions operate and are adjusted the same way. At first blush an older movement may appear to be missing its player drum drive are, but may just be the older design.



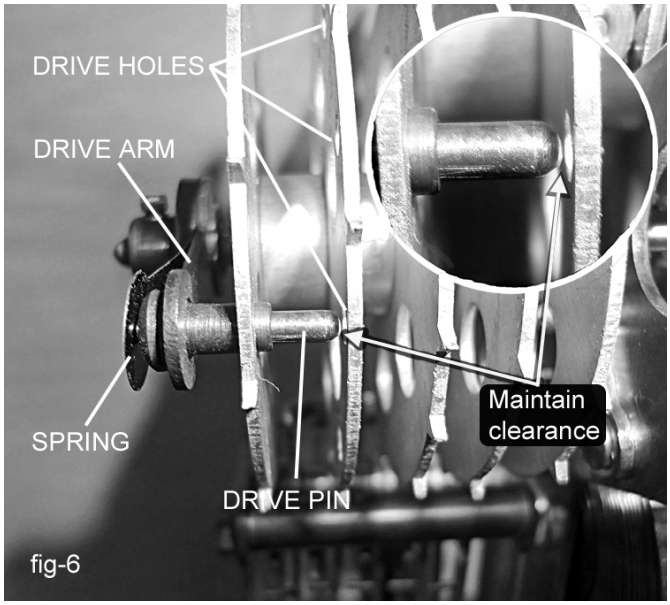


Make sure that the minute hand is still in the 12:00 o'clock position and that the locking lever is in the slot in the locking plate as shown in fig.-1 pg. 16. Check the locking pin (fig-8) to be sure it is snug in the locking pin arm and that the tip of the pin is smooth. Put a small dab of grease on the lifting fork that will shift the player drum and place a small drop of oil on the player drum shaft where it exits the back plate (between the fork arms) and on the shaft itself. Slip the 4-disk chime drum assembly onto the shaft and rotate it until the locking pin engages the locking hole in the bottom of the drum. With the movement supported in the normal operating position, observe whether any of the bell rod hammers are partly raised. If any of the hammers have not been fully released by the chime drum tappets or "pins", remove the chime drum and slightly reposition the locking pin arm shown in fig-8 and check again. Before proceeding to set the drive arm it is important that the locking pin and arm be positioned such that all the hammers are fully released when the chime

drum locks at the 12 o'clock position. This is an often overlooked but critical adjustment. The mounting holes in the chime hammer assembly are often oversize. Repositioning the hammer assembly may help ensure that all hammers are down in the 12 o'clock position.

With the chime drum locked on the locking pin (fig-8 page 21) and all bell rod hammers fully released, install the strike disk (fig-5 page 21) on the shaft with the flat side up (hub side down). Place the small spring on the shaft. Note that the spring goes inside the drive arm hub and pushes all five player drum disks toward the back of the clock movement. It is a common mistake to place the spring in the hub between the strike disk and the chime disks.

The drive arm (fig-5 pg. 21 and fig-6 right) goes on next. Sessions used at least two variations of the drive arm. The earlier version has a rigidly mounted pin as shown in fig-5 and the later "improved" version has a spring-loaded retractable pin as seen in fig-6. The spring loaded pin is intended to prevent jamming in the case of misalignment but either arm will perform satisfactorily when properly aligned; the installation and adjustment procedure is the same. Note however, that the strike disk has a larger drive hole when the spring loaded drive arm is used and is not interchangeable with the strike disk used with the ridged pin arm.



The drive arm is installed with the drive pin passing through the outer striking disk and is aligned directly over one of the holes in the disk below. It does not matter which hole. Press the drive arm onto the shaft until the tip of the drive pin is just slightly above the chime disk below (fig-6). When the clock is striking (minute hand in the 12 o'clock position) the outer strike disk must be free to rotate without the drive pin contacting the inner 4-disk chime drum assembly. A thin feeler gauge may be placed between the drive pin and player drum to help maintain clearance. A few thousandths of an inch is enough. Tighten the two set screws in the drive arm and make sure drive pin is still directly centered over a drive hole in the chime disk below.

Gently move the chime drum assembly (the 4 inner disks) rearward. The drive pin should smoothly slip into the drive hole in the second disk. If not, readjust the drive arm position. Now advance the minute hand to the 3 o'clock position. The chime drum should move outward and slip smoothly onto the drive pin. If the drive pin does not engage smoothly, return the minute hand to the 12:00 o'clock position and readjust the drive arm until it does. If the chime player drum fails to move far enough to securely engage the drive pin, review the section on installing the small back plate cam. When the cam follower is not on the slope of the cam

the follower and the fork under the player drum must not be under tension but as soon as the cam follower starts up the slope, the lifting fork under the player drum should begin moving the player drum outward. Continue advancing the minute hand through each quarter stopping at the 12 o'clock position. All five disks will turn until the player drum has made one full revolution after which the assembly shifts inward toward the back of the movement where the four inner disks disengage from the drive pin and remain stationary while the outer 5th disk continues to rotate and the single outer hammer strikes the hour count.

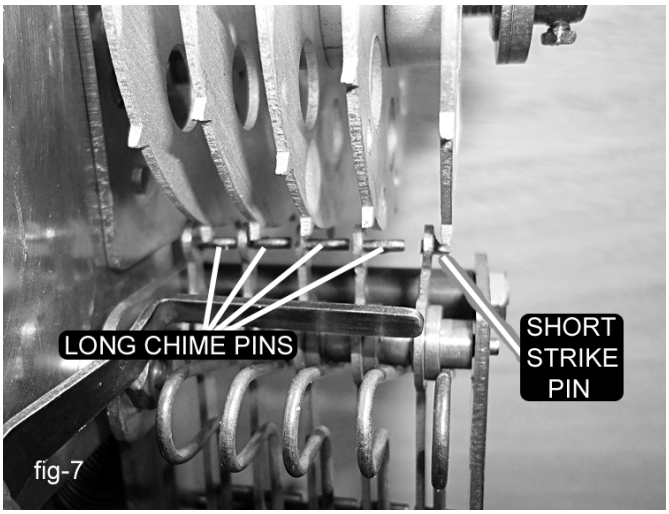


fig-7

Note that each of the fiver brass chime levers has a steel pin in the end and the outermost strike lever is identical except the steel pin in the end of the strike lever is about half as long. (fig-7 right). During operation when the player drum is in its outward chiming position (not on the locking pin) the tappets on the outer strike disk pass by the end of the short pin of the strike lever, but when the player drum shifts inward and locks, the tappets on the outer strike disk contact the short pin and lift and drop the strike hammer as the disk rotates. If everything is assembled correctly the player drum will be in the correct position to chime or strike, however, it is not uncommon to discover that a previous repairer has either bent the end of the brass strike lever or added shims or spacers to achieve a working alignment of the strike lever pin and the strike disk tappets. Such methods should not be necessary if the cam and lifting fork are properly aligned except in cases of severe wear or alteration of the playing wheel have occurred. Before continuing it is essential that proper alignment of the strike disk and strike lever pin be obtained to ensure that the strike pin is never contacted by the strike disk tappets during chiming and always contacted during striking. Intermittent contact with the strike lever pin during striking can easily be mistaken as a malfunction of the racks and snails.

The final adjustment of the strike train is made under power so wind the strike side main spring part way and remove the main spring restraint. Advance the minute hand from the 12 o'clock position to the 3 o'clock position. The player drum should shift outward and each of the four chime hammers in succession should lift and drop as the player drum rotates. Repeat for the 6 o'clock position where there should be 8 hammer drops, then repeat for the 9 o'clock position where there should be 12 hammer drops. Each time when the chiming stops all four hammers must be in the released or "dropped" position. If the last hammer to be raised fails to drop, or the chiming finishes and one hammer begins to rise then the locked position of the player drum will need to be adjusted. This adjustment normally is not necessary unless someone has "messed with" the original factory setting but the problem is easily corrected. Referring to (fig-8 pg. 21), move the locking pin arm just slightly to advance or retard the locking of the player drum. This adjustment will require a readjustment of the drive arm to

realign the drive pin over one of the holes in the chime disk assembly which must be done with the minute hand in the 12 'o clock position. The locking pin arm is held by a rivet and may be very tight, as it should be. Do not proceed to the next step until this locking adjustment is correct and no hammer is left raised and no hammer begins to rise during the warning run and that the drive arm pin is centered over the hole in the second player disk. The adjustments are critical and usually require several attempts before everything is perfect.

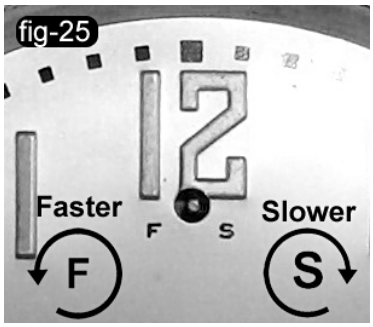
The final step is to move the minute hand to the 12 o'clock position. The player drum should rotate and there should be 16 hammer drops playing four groups of four notes for a total of 16 notes after which the player drum should shift inward and lock leaving the outer strike disk to continue rotating lifting and dropping just the strike hammer for the proper hour count before stopping. All hammers should be in the fully released position after chiming and striking is complete. A small bit of crease may be placed on each of the hammer lever pins.

The chime silencing lever should now be installed. This was left for last just in case the plates had to be separated to correct some problem. These clocks are known to have a number of little variations in design during the years they were produced. Fig-9 right shows a movement where the chime silence shaft is held with a steel pin instead of the more common pressed on brass collar. The writer is unsure if this was a factory design change or the work of some enterprising clock repairer to make future disassembly easier. There should be a steel spring or cup washer between the movement plate and collar on one or both sides of the plate. There should be enough tension to hold the lever while allowing the key to turn the arbor without excessive force.


fig-9 Chime silence shaft with retaining pin

This completes the assembly and adjustment of the chime/strike train and if everything was done correctly the chiming and striking should function properly with no further adjustment other than aligning the hammers with the bell rods when the movement is installed in the clock case. The time side main spring should now be wound and the pendulum suspension spring and leader installed. All of the pivots should be oiled with good clock oil, and the pallets lightly oiled. The writer recommends running the completed movement on a suitable test stand for a few days before reinstalling in the case.

REGULATING THE CLOCK



Final regulation of the clock should be done with the clock located where it will actually be used. Spring powered clocks like these with simple recoil escapements tend to run a little fast just

after being wound and usually slow near the end of the week. Always begin regulating with the clock fully wound and allow the clock to run seven days before making another rate adjustment. The rate is adjusted by inserting the small end of the winding key into the small hole under the "12" (fig-25 page 23) and turning it clockwise to slow the clock or counterclockwise to speed up the clock.

TROUBLE SHOOTING CHECK LIST

Clock does not run at all

- **Spring not wound** – These clocks, and many other Sessions clocks, wind to the left (counter clockwise). That is contrary to one's natural tendency to wind or tighten things "to the right". It is not uncommon for one to assume that the clock is fully wound or "wound too tight" when the clock is not wound at all after attempting to turn the key clockwise and finding that it will not turn.

- **Main spring won't wind** – Winding key turns and begins to tighten the spring but springs back to its original position when released. This indicates a click failure. Either the *click* (the ratchet dog on the main wheel that keeps the spring from unwinding when the key is released) is either broken or stuck or the click spring has broken.

- **Dirt and/or lack of lubrication** – A combination of dried up old oil and dirt in the pivot holes is the most common cause of a clock not running, especially if it has been sitting for a long time.

- **Excessively worn pivot holes and pivots** – Like any other mechanical clock, when the pivot holes become excessively worn the wheels and pinions no longer engage properly.

- **Bent or damaged pivot** – The movement must be disassembled to evaluate pivot condition. Bent pivots are often the result of assembly by an inexperienced clock repair person.

- **Hour/Minute hands jammed** – Insufficient clearance between the hour hand and minute hand can result in the clock stopping when the minute hand tries to "pass" the hour hand.

- **Damaged wheel or pinion teeth** – A bent or broken tooth or teeth on a wheel or pinion will obviously prevent the clock from running.

Clock starts but will not keep running

- **Clock is not in beat** – Simply stated, the time interval between the *ticks* and the *tocs* is not equal. This results when the pendulum has to swing further to one side of center to release an escape wheel tooth than it does when it swings to the other side. The clock will have an uneven sound as it attempts to run. If raising one side of the clock or the other results in an evenly spaced ticking sound the clock is "our of beat". The beat is set on this clock by forming (bending) the brass crutch wire a little toward the side of the clock that was raised when the beat was even after which the clock should be in beat on a level surface. Setting the beat is covered in detail in any good book on basic clock repair. Many clock shops use a digital instrument to set the beat precisely.

- **Escapement out of adjustment** – CAUTION: one should not fool with escapement adjustments until one has a basic understanding of how the recoil strip-pallet escapement functions and understands the proper procedure for adjusting these. This is included here because clocks arriving for repair have often been "messed with" earlier in an unsuccessful attempt to make them run. The main concern here is that the pallet strip (verge) has not been set so close to the escape wheel that it occasionally "snags" on a tooth tip (or so far away that it occasionally skips a tooth). If the verge has been adjusted and the clock subsequently runs but will not keep running, there may be parts in the clock movement that need repair or replacement. Instructions for adjusting a recoil escapement can be found in any good book on basic clock repair.

- **Insufficient space between the chime and hour snail** – If the clock was assembled with the outer (hour) snail pressed up tight against the smaller chime snail tightening the set screw in the hour snail collar can cause friction between the two snails that can cause the clock to stop after running strong for a few minutes. When properly installed, the small snail should feel loose on the hour pipe and have just a little end play. (see page 17).

- **Strike rack not fully gathered at 12 o'clock** – If the chime/strike side of the clock is run down or intentionally not wound, or if there is a problem with the chime/strike train that prevents the train from running and the hour rack is released at "12" and not gathered it can jam against the 12-1 wall on the snail as it advances and cause the clock to stop. The solution is to correct the problem with the chime/strike train.

- **Clock stops just before chiming and/or striking** – this can result from a bent or binding lever in the chime/strike train. The minute hand should be able to be turned all the way around the dial with no noticeable additional friction or binding as the chime/strike points are approached and passed. If extra resistance is felt one should investigate the cause of the friction in the chime/strike train.

- **Clock runs weakly and stops randomly** – The pendulum swing is weak, maybe only ½ inch total, and the clock stops randomly and is more likely to stop after the clock has run for a few days. This indicates a lack of power getting to the escape wheel and may be difficult to diagnose as the cause may be one thing or a combination of several things. A clock running with a weak pendulum swing becomes increasingly unstable as the swing diminishes. Even a small amount of "beat error" can stop a clock in this condition. Usually the cause is excessive friction somewhere in the going (time) train. That can be from improperly fitted pivot hole bushings, rough or bent pivots, lack of lubrication including lack of lubrication on the main springs, or a bent wheel or damaged pinion. A week tired or "set" main spring may exacerbate the problem but is seldom the sole reason for a clock stopping. Rough pallet faces on the verge, incorrect pallet angles and spacing or incorrect verge alignment may be the cause. If the "drops" of the escape wheel teeth onto the pallet faces are excessive (and the locks minimal) the clock will not run strong.

- **Crutch foot loop binding pendulum leader** – The pendulum leader rod must be free to move anywhere in the crutch foot loop without binding. Any contact between the pendulum leader rod and both sides of the crutch foot loop simultaneously will stop the clock. A small clearance must be maintained at all times. This point should be oiled.

- **Crutch foot loop clearance excessive** – Excessive clearance between the pendulum leader rod and the crutch foot loop results is lost power that will not be transferred to the pendulum. The clearance must be minimal but there must be some clearance. 0.002" is enough.

- **Pendulum leader rod not centered in crutch foot loop** – A proper relationship between the pendulum leader rod and the crutch loop is critical if the clock is to run properly. With the clock on a level surface the pendulum leader rod must hang in the center portion of the crutch loop foot. If the pendulum leader rod rubs against either end of the crutch foot loop the clock will surely run weakly or stop.

- **Pendulum interference** – The space available to the pendulum, pendulum leader rod, and the crutch is limited in these clocks and especially so in models where the bell rods are mounted on an angle behind the movement rather than under the movement. One must ensure that the crutch and pendulum bob never contact the small cam or any of the other parts on the rear of the movement.

- **"Set" main spring** – After many years the main springs start to become tired or "set" and no longer deliver full power. While this condition is seldom the only reason for a clock failing to run, it can be a factor. An incorrect replacement

spring can have the same effect. Sometimes the solution is to just wind the clock a few turns mid-week until a correct replacement spring can be located.

Clock runs but does not keep good time

- **How good is good?** – "Good" compared to what? Eighty to a hundred years ago or more people went to church on Sunday and stayed all day. No one really cared much about the precise time unless one was running the railroad. Most folks were lucky to have just one clock and whatever time it indicated was the time at that place. These clocks are from that period. They are not precision clocks and they do not and cannot keep perfect time. That being said, with patience one can usually get the clock to end the 7-day weekly run within a minute or two of where it was set at the start of the week. It may however gain a little at the start of the week and slow a little as the weak wears on. They are not temperature compensated so expect some seasonal changes as well. In this day of precise digital time, even from inexpensive quartz time pieces, one sometimes simply expects more timekeeping accuracy from these old clocks than they are capable of delivering.

- **Isochronism** – Or perhaps more properly the lack of same is a condition that affects all spring powered clocks to some degree. The main spring delivers more power immediately after being wound and forces the clock to run at a slightly faster rate. As the spring runs down the clock will also slow down. Relatively inexpensive clocks like this with recoil escapements are affected more than deadbeat clocks. A variation of 3 or 4 minutes over a week is not considered abnormal. The affect can be minimized by making sure the clock is in beat and that the escapement locks and drops are properly set. A weak or "set" main spring can exacerbate the problem. Using a slightly longer main spring may help but one is advised against using a thinner spring in this application.

- **Incorrect suspension spring or pendulum** – The rate at which the clock runs is determined by the over-all length of the pendulum and suspension parts. More technically stated, the rate is determined by the distance from the flexing point of the pendulum suspension spring to the center of gravity of the complete pendulum assembly, which will be just above the center of the pendulum weight or "bob". The rate is also affected but to a lesser extent by the thickness of the pendulum suspension spring. Pendulum parts tend to get lost and replaced with different parts over the years. If incorrect part substitutions were made, one may need to replace the suspension spring and leader rod assembly for one of a slightly longer (to make the clock run slower) or shorter (to make the clock run faster) suspension assembly.

- **Incorrectly mounted suspension spring** – This clock has an adjustable rate mechanism that supports the pendulum. The upper end of the suspension spring slips into a slot at the top of the mechanism and is held stationary. The end of the spring may have a "dimple" punched into it or a small hole through which is tied a small wire to keep the spring from pulling out. The midsection of the suspension spring slips between two "chops" or jaws which can be moved up or down as the adjusting screw turns thus shortening or lengthening the length of the moving parts of the pendulum assembly. If the end of the suspension spring is mounted in the "chops" instead of the stationary supporting bracket at the top of the adjuster the rate adjuster will not function and the clock will run slow. This problem may be corrected by mounting the suspension spring properly.

<u>Clock does not strike or chime at all</u>

- **Chimes set to the silent position** – Don't overlook the simple explanations.

- **Chime/Strike main spring not wound -** These clocks, and many other Sessions clocks, wind to the left (counter clockwise). That is contrary to one's natural tendency to wind or tighten things "to the right". It is not uncommon for one to assume that the clock is fully wound or "wound too tight" when the clock is not wound at all after attempting to turn the key clockwise and finding that it will not turn.

- **Chime/Strike main spring won't wind** – Winding key turns and begins to tighten the spring but springs back to its original position when released. This indicates a click failure. Either the *click* (the ratchet dog on the main wheel that keeps the spring from unwinding when the key is released) is either broken or stuck or the click spring has broken.

- **Rack tail bent or not adjusted** – If the rack tail is bent, damaged, or incorrectly adjusted, when the rack is released in may be incorrectly positioned to gathered by the gathering pallet on the first note to be played. When this happened the gathering pallet may lock against the tip of the rack tooth causing all further action of the chime/strike train to abruptly end. The solution is usually to manually "back up" the chime/strike train to release the gathering pallet and then slightly adjust the rack tail suck that the gathering pallet engages the rack between the teeth. This is only an issue on the first tooth gathered. After that the rack hook ensures that the rack is maintained in the correction position to be gathered.

- **Dirt and/or lack of lubrication** – A combination of dried up old oil and dirt in the pivot holes is the most common cause of a clock not running, especially if it has been sitting for a long time.

- **Excessively worn pivot holes and pivots** – Like any other mechanical clock, when the pivot holes become excessively worn the wheels and pinions no longer engage properly.

- **Bent or damaged pivot** – The movement must be disassembled to evaluate pivot condition. Bent pivots are often the result of assembly by an inexperienced clock repair person.

- **Damaged wheel or pinion teeth** – A bent or broken tooth or teeth on a wheel or pinion will obviously prevent the clock from chiming.

- **Missing parts or incorrect assembly** – by previous repairer.

- **Bell rod hammers or player drum jammed** – Inspection should reveal the cause of the problem.

- **Bell rod hammers set too far from bell rods**. The chime/strike train operates but produces no sound.

Clock chimes and strikes early or late – not exactly on the quarter hr.

- **Perhaps it is normal?** – A certain amount of backlash or "free play" of the minute hand is normal in this type of American clock. Generally plus or minus one minute or less before or after is considered acceptable.

- **Minute hand bent or on upside down** – Remove the minute hand and turn it over and reinstall. If it points to a different place on the dial it is likely bent. Straighten the hand or leave it if reversing sides solved the problem. Sessions hands are easily bent and frequently found that way.

- **Minute hand loose** – The minute hand is held in the correct position on the end of the center shaft by a rectangular hole in the hand that fits over a matching shape on the end of the shaft, sometimes the hole in the hand becomes enlarged from years of use or a sloppy attempt to refit a replacement hand. Usually a loose hand can be tightened by applying a flat tip punch around the edges of the hole. One can also punch at opposite corners of the hole to slightly shift the position of the hand.

- **Dial incorrectly positioned** – Loosen the screws holding the dial and see if it can be positioned to correct the problem. This happens mostly when a previous repairer has stripped the "threads" in the wood and inserted the screw in a new location.

- **Clock movement incorrectly located in the case** – The movement is mounted with four flat-head wood screws which should properly locate the movement when the screws are tightened. After a number of removals the "threads" in the wood often become stripped. Frequently one will discover where a previous repairer has inserted match sticks or tooth picks in the hole to tighten the screw thereby shifting its position slightly. Sometimes the mounting feet on the movement will be turned to a new location and the screw inserted in a different location which may or may not leave the movement properly positioned. The two large winding arbors, the center shaft, and the small arbors to adjust the rate and silence the chimes should all be centered in their respective holes in the dial when the movement is correctly positioned.

- **Strike/chime lifting lever bent** – Between the plates of the movement is a small flat metal lever with a pointed end that is lifted and released each quarter hour by the four-point star wheel on the center shaft. Chiming begins when this lever is dropped by the star wheel. If the lever or the end of the lever is bent the chimes will begin early or late. Reforming the end of the lever to change its contact point with the arms of the star wheel may correct the problem. A small adjustment can make a significant change.

- **Star when positioned incorrectly or damaged** – The four-point star wheel is pressed onto the canter shaft rather tightly and precisely positioned at the factory. One should not attempt to correct a chime point error by repositioning the star wheel unless one is very sure that it has been previously messed with.

<u>Clock chimes incorrectly and/or sounds the wrong hour count</u>

This is the most common complaint when a Sessions two-train comes in for service. Because the chiming and striking functions are totally integrated into a single train a striking error will also throw off the chiming and a chiming error will through off the striking. A single position count error in the chime function can through off the strike count by several counts. It is nearly impossible, even for the experienced repairer, to pin point the problem simply by listening to the chime and strike sounds. It is also nearly impossible to correct an improperly adjusted chime/strike train by making random trial and error adjustments. All adjustments should be made with the movement in the 12 o'clock position as described above in the section on reassembly. The following are a few of the causes of chime/strike problems that one sometimes sees in the shop for servicing and possible solutions.

- **Chimes not synchronized** – This condition may develop if the time is set without waiting for the chiming and striking to complete on the quarter hours, or when the chime/strike main spring has run completely down. Allow the clock to run for

a couple hours. The player drum will lock the first time it crosses the "12" position and the clock should self-correct. If there are no mechanical problems with the clock, the chimes will now be synchronized and the next hour should chime and strike correctly.

- **Strikes wrong hour count and is always off the same amount** – If the clock always strikes on the hour but the count is always off by the same amount AND the clock never strikes more than 12 times on the hour, the problem is likely that the hour hand has been accidentally moved, or intentionally moved in an attempt to set the time. The hour hand is a friction fit. Simply move the hour hand to correspond with the hour last struck. Once set to the correct position the hour hand should not require readjustment.

- **Clock strikes the hour at half past the hour** – Most likely the minute hand is installed in the wrong position. Remove the hand and turn it 180 degrees and reattach.

- **Clock chimes OK but strike is intermittent and erratic** – Player drum may not shift far enough in to allow outer disk to engage the short strike lever pin shown in fig-6 page 19. Chime hammer head too far away from bell rod.

- **Clock chimes every quarter but does not sound the last note**
  The player drum drive arm is not advancing the drum far enough to release the last hammer which is left raised. Re adjust the player drum locking pin arm in the 12 o'clock position to allow the drum to advance slightly more before locking. Then readjust the drive arm and drive pin position.

- **Clock stops chiming and striking near the end of the week.**
  - The clock may need cleaning and oiling
  - The clock may have worn or rough pivots and/or pivot holes
  - The player drum may be advanced too far causing the chiming to stop with one or more hammers raised. The strike train may not be able to start under load on a rundown spring. Readjust the player drum locking pin arm.
  - The clock may not have the correct main springs. See discussion on pg. 11

- **Clock chimes erratically, strike count is off but not always by the same amount.**
  These symptoms may be caused by any one of a several conditions or combinations of conditions. Following the reassembly checks and adjustments described in that section of this article will usually reveal and correct the problem. Check the following:
-

- Both rack springs installed and not damaged. A stretched or damaged rack spring may prevent the rack from moving completely into position.

- Both racks must move freely on the mounting post – Check for old stiff oil on the post. The rack post should NOT be oiled.

- Rack locking lever must move freely of its post (do not oil)

- Both gathering pallets must be in place and straight.

- Gathering pallets must clear rack teeth in stop position and at the end of the “warning run”.

- Chime rack tail must contact middle of flat on snail. The snail drive pinion may be moved one tooth to correct this problem.

- The two locking teeth on the rack locking lever must be tight and correctly positioned to allow the rack to gather one tooth at a time. The “flat” on the rack hook pins (both) must be as shown in fig-20, and both pins must be secure.

- Strike rack tail is set close to the “12-1 wall” at 12 o’clock but not hitting the “12-1 wall”.

- Chime rack advances 1 tooth for each qtr. (4 teeth at “12”). If not, adjust rack tail (usually only a problem with old style rack).

- The Chime rack only should release at the first three quarters and both racks should release “on the hour”. The lifting arm that raises the rack locking lever can be formed (bent) slightly to achieve this condition.

- Cam follower must be at position shown in fig-14 pg. 15 at 12 o’clock.

- The small coil spring is in place under the player drum drive arm as shown in (fig-5 pg. 21).

- Player drum drive arm and pin positioned as shown in (fig-7 pg. 23).

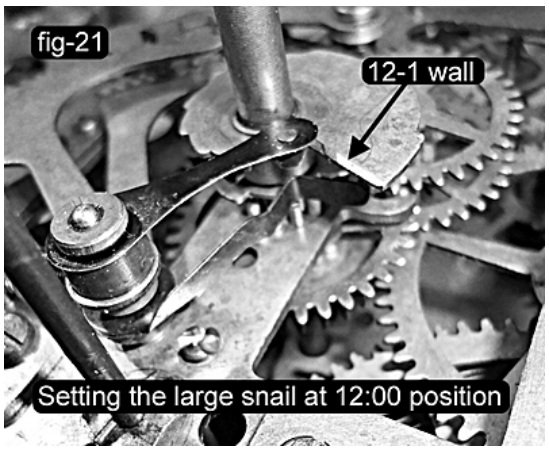
- The rear plate cam may not be correctly positioned, or the cam follower may not be completely releasing the player wheel to unlock at the 3

o'clock position. This usually indicates that cam has been pressed too far onto the center shaft or installed in an incorrect position.

- **Clock will not chime on the first quarter hour but will chime 2nd, 3rd, and 4th quarter if "helped" past the first quarter.**
  One possible cause is that the player drum is not being completely lifted off of the locking pin stalling the strike train. Check that the small cam on the back plate has not been pressed on too far and that the lifting arms under the player drum are not bent, see section on reassembly and adjustment of these parts, (fig-8 pg. 21).

  Another possibility, especially on older style movements with flat strip rack tails, is that the rack tail has been bent causing one of the gathering pallets to hang up on the tip of one of the teeth on the rack instead of engaging the rack between the teeth.

APPENDIX



US Patent 1,837,642 Dec. 22, 1931 (Original Design) Text Pages 1 to 12*

US Patent 1,837,642 Dec. 22, 1931 (Original Design) Drawing Sheets 1 to 5*

US Patent 1,883,387 Oct. 18, 1932 (Improved Design) Text Pages 1 to 8*

US Patent 1,883,387 Oct. 18, 1932 (Improved Design) Drawing Sheets 1 to 4*

* Page numbers above are those of the patient document

Patented Dec. 22, 1931 1,837,462

UNITED STATES PATENT OFFICE

SAMUEL MAZUR, OF BUFFALO, NEW YORK, ASSIGNOR TO THE SESSIONS CLOCK COMPANY, OF FORESTVILLE, CONNECTICUT, A CORPORATION OF CONNECTICUT

CLOCK

Application filed May 10, 1926. Serial No. 108,044.

This invention relates to a clock which strikes the hours and also chimes the four quarters of each hour.

Heretofore clocks having this capacity employed three distinct sources of power, usually springs, one of which furnished the power for the time mechanism, another the power for the hour striking mechanism, and still another for operating the chime mechanism every quarter of an hour. Clocks of this type were therefore quite elaborate and expensive which limited their use to persons of ample means.

It is the object of this invention to provide a clock in which the striking mechanism and the chime mechanism are driven from the same prime mover, in this instance a single spring, thereby not only simplifying the construction and rendering the same more compact, but also materially reducing the cost and the liability of derangement and enabling such clocks to come into more general use.

In the accompanying drawings:—

Figure 1 is a front elevation of a clock embodying an approved form of my invention and showing the parts in the position which they occupy when the time mechanism only is in operation.

Figure 2 is a side elevation of the same.

Figure 3 is a front elevation, on an enlarged scale, showing the position of the parts when the clock is about to chime four quarters and strike the twelfth hour, and the hour and minute hands omitted.

Figure 4 is a rear elevation of the clock.

Figure 5 is a fragmentary vertical section taken on line 5—5 Fig. 4, but also showing the strike mechanism cut out and the chime mechanism in its operative position.

Figure 6 is a fragmentary vertical longitudinal section on an enlarged scale, taken on line 6—6 Fig. 3, but showing the parts in the position which they occupy at half past twelve o'clock.

Figure 7 is a fragmentary vertical longitudinal section on an enlarged scale, taken on line 7—7 Fig. 4, and showing the strike mechanism in its operative position and the chime mechanism cut out.

Figure 8 is a fragmentary cross-section taken on line 8—8 Fig. 7.

Fig. 9 is a fragmentary cross-section taken on line 9—9 Fig. 5.

Figure 10 is a perspective view of the mechanism which controls the release of the motive power for driving the chime and striking mechanism and which is commonly known as the "wish bone".

Figure 11 is a similar view of the locking disk forming part of the means for preventing the power from operating the chime and striking mechanism and also the lifter and pinion forming part of the means for operating the chime and striking mechanism.

Figure 12 is a similar view of the locking arm and lifting wire forming parts of the stop mechanism for controlling the operation of the chime and striking mechanism.

Figure 13 is a similar view of part of the mechanism for operating the chime and striking gongs or rods.

Figures 14 and 15 are fragmentary front elevations of the striking and chiming snails and associated parts of the mechanisms which control the operation of the chime and striking mechanism.

Figures 16, 17, 18, 19 are cross sections, on an enlarged scale, taken on line 16—16 Fig. 1, showing different positions of the detent pawls.

Similar characters of reference indicate like parts in the several figures of the drawings.

The main frame of this clock may be of any suitable construction to support the various working parts but in the preferred construction shown in the drawings, the same comprises upright front and rear plates 20, 21 which are connected by horizontal rods or posts 22, and an upright auxiliary plate 24 arranged in rear of plate 21 and connected with the latter by horizontal posts 25. The numeral 26 represents the tubular shaft or socket which carries at its front end the hour hand 27 and which is journaled in a suitable bearing in the front plate in the frame. Turning within this hour shaft 26 and also journaled on the rear plate 21 is a center post or minute shaft 28 which carries at its front

end the minute hand 29 of the clock. Motion for driving the hour and minute shafts 26 and 28 is derived from the main or time spring 30 and is transmitted to these shafts for turning the minute shaft twelve times during one rotation of the hour shaft, the means for this purpose being well known and consisting generally of a winding gear wheel 31 operatively connected with the main or time spring, a gear pinion 32 meshing with the winding gear wheel 31 and connected with a gear wheel 33, a gear 34 secured to the minute shaft 28 and meshing with the gear wheel 33, a gear pinion 35 secured to the minute shaft and meshing with a gear wheel 36, and a gear pinion 37 connected with the gear wheel 36 and meshing with a gear wheel 38 on the hour shaft 26, as shown in Figs. 1, 2, 3, 4 and 6. The gears 36 and 37 are mounted on an intermediate shaft 39 which is journaled in the front and rear plates of the frame, shown in Fig. 6. The rotation of this train of gearing is retarded by the usual retarding mechanism which comprises a gear pinion 40 meshing with the intermediate gear wheel 33 and connected with a gear wheel 41, a gear pinion 42 meshing with the gear wheel 41 and connected with the gear wheel 43, a gear pinion 44 meshing with the gear wheel 43 and connected with an escapement wheel 45, and an oscillating pallet 46 engaging with the escapement wheel, as shown in Figs. 1, 2, 3 and 4.

This time mechanism has certain elements whereby the same cooperates with the chime and striking mechanism for maintaining these mechanisms normally in synchronism and cause the chime and striking mechanism to operate at the proper time. These means which will now be mentioned but described more fully later on consist of a shifting cam 47 secured to the rear end of the minute shaft so as to turn therewith once per hour; a tappet or star wheel mounted on the minute shaft and having three tappets or short teeth 48, 49, 50, and a long tappet or tooth 51 arranged equidistant around the axis of the minute shaft on the different quarters thereof; a striking snail 52 arranged on the tubular hour shaft and having twelve steps which correspond to twelve hours of the day and are arranged successively nearer to the axis of this shaft beginning with the first hour and ending with the twelfth hour; a chime snail 53 turning about the axis of the hour and minute shaft and preferably journaled on the tubular hour shaft, as shown in Fig. 6; and a gear wheel 54 secured to the front end of the intermediate shaft 39 so as to turn with the gears 36 and 37, and meshing with a gear pinion 55 on the chime snail 53.

The numeral 56 represents a main driving shaft from which motion is transmitted to the striking and chime mechanism of the clock as will hereinafter appear. This shaft is journaled lengthwise and horizontally in bearings in the front, rear and auxiliary plates of the main frame, as shown in Figs. 1, 2, 3, 4 and motion is transmitted by a main spring 57 to this main shaft so that the chime mechanism and the striking mechanism both receive their power from the same spring for operating the chime mechanism at each of the four quarters of every hour and the striking mechanism at each hour of the day. The train of gearing for transmitting motion from the main spring 57 to the main shaft 56 is so organized that a greater number of turns are obtained for operating the striking and chime mechanism than are usually obtained for operating the striking mechanism only, and for this purpose this speed increasing train of gearing preferably comprises a main or winding gear wheel 58 connected with the main spring 57 and meshing with a gear pinion 59, and a gear wheel 60 connected with the pinion 59 and meshing with a gear pinion 61 on the main driving shaft 56, as shown in Figs. 1, 2, 3 and 4. For the purpose of retarding the motion of this train of gears under the action of the main spring 57, a retarding or brake device is provided which preferably consists of a gear wheel 62 connected with the pinion 61 and meshing with a gear pinion 63, a gear wheel 64 connected with the pinion 63 and meshing with a gear pinion 65, a gear wheel 66 connected with the pinion 65 and meshing with a gear pinion 67, and a rotary fly or fan blade 68 connected with the pinion 67 and adapted to produce a resistance when rotating in the air.

The gear pinion 63 and gear wheel 64 are mounted on a lifting shaft 69 which is journaled in the main frame and which forms parts of the mechanism for operating the chimes and the strokes of the clock.

When the chime and striking mechanism are not in operation the main spring 57 is prevented from turning the shaft 69 and the parts geared therewith, this being accomplished in the present case by a locking disk 70 secured to the shaft 69, and a vertically swinging locking arm 71 having a locking finger 72 adapted to engage with one or the other of two notches 73 formed in the periphery of the locking disk 70, as shown by dotted lines in Fig. 11. Upon raising the locking arm 71 the disk 70 is released and the mechanism geared to the shaft 69 is permitted to operate as will presently appear. The lifting of the locking arm 71 is effected by a lifting shaft 74 to which it is connected and which is journaled on the main frame, a lifting arm 75 connected with the lifting shaft and provided with a lifting finger 76, a controlling rock shaft 77 journaled on the main frame and provided with a controlling arm 78 adapted to engage with the underside of the lifting finger 76 and lift the same, and a tappet arm 79 secured at its upper end

to the controlling rock shaft 77 and provided at its lower end with a laterally projecting lug 80 adapted to engage with one or another of the teeth or tappets of the star wheel.

At the end of every quarter hour one of the tappets of the star wheel engages with the lug of the tappet arm and turns the same so as to lift the arms 78, 75, 71 and disengages the latter from the locking disk 70 thereby permitting the spring 57 to turn the shaft 69 and the parts geared therewith. At this time however the shaft 69 is only permitted to turn for a short time to put the mechanism in warning condition preparatory to actually sounding the chimes alone at the first, second and third quarters of the hour, or sounding the chimes four times and following the same with the sounding of the strike at the end of each hour.

This warning control is effected in the usual and well known manner by a warning pin 81 on the gear wheel 66 which is engaged by a warning stop arm 82 on the controlling shaft 77. When therefore, the locking arm 71 is released from the locking disk 70 the warning arm 82 at the same time moves across the path of the warning pin 81 whereby the gearing is only permitted to advance far enough to carry the respective notch 73 of the locking disk out of register from the locking lug 72 of the locking lever. When therefore the respective tooth of the star wheel again clears the tappet arm the latter can swing backwardly for disengaging the warning arm 82 to release the warning pin and permit the train of gearing associated therewith to advance as far as required, because at this time the respective locking notch notch 73 has moved forwardly out of register with the locking lug 72.

Inasmuch as the locking disk at times is obliged to make one or more complete rotations in order to properly sound the chimes and strike the hour, means are provided for preventing the locking arm for re-engaging a notch 73 until after the required number of quarter chimes and hour strikes have been given. This is accomplished by means which operate to hold the locking arm 71 out of operative engagement as long as required and these means, in the present device comprise a trip arm 83 connected with the controlling shaft 77, a detent arm 84 which performs an additional function to be described later on, but for the present purpose is pivoted on the main frame and engaged by the trip arm, an intermediate lever pivoted on the main frame and having a lower arm 86 adapted to be engaged by the detent arm 84, a cam arm 87 pivoted on the main frame and adapted to be engaged by the upper arm 88 of the intermediate lever, and a cam 89 formed in the lower end of said cam arm and adapted to control the engagement of the locking arm 71 with the notches of the locking disk 70. The intermediate lever 86, 88 has a weight 90 which operates to turn the same by gravity in the direction for engaging its lower arm 86 with the detent arm. When therefore the locking arm 71 is raised by the star wheel to release the locking disk the cam 89 holds the locking arm in its inoperative position until the detent arm returns to its normal position, as will be described later on, thereby insuring turning of the locking disk 70 and the parts associated therewith the requisite extent.

When the detent arm 84 returns to its normal position after the chime and stroke operations have been effected, the cam 89 is moved by gravity in the direction for permitting the locking arm 71 to re-engage the locking disk 70 and stop the counting device associated with the chime and striking mechanisms and the sounding operations of the latter.

If desired, an auxiliary stop may be provided for directly arresting the rotation of the fan blades 68, this being accomplished by a stop arm 91 arranged on the shaft 92 which carries the fan gear wheel 66 and a shoulder 93 arranged on the cam arm 87 and movable out of the path of the stop arm 91 to permit the fan to turn when the chiming and striking mechanisms are released for operation and to move into the path and arrest the rotation of said stop arm when the rocking arm 71 is re-engaged with the locking disk and stop the operation of the chiming and striking mechanisms.

Those parts of this invention whereby each quarter hour and each hour is sounded are constructed as follows:—

Slidable lengthwise on the main shaft 56 between the rear frame plate 21 and the auxiliary frame plate 24 is a chime drum which may be variously constructed but which as shown in the drawings, see particularly Figs. 2, 5 and 7, comprises a hub 94 mounted on the shaft 56 so as to be capable of sliding lengthwise and also at times turning therewith and at times held against turning with the same, two disks 95 and 96 carried by said hub, and four annular rows of tappets or pins 97, 98, 99 and 100 carried by said disks, the two rows 97 and 98 being preferably mounted on opposite sides of the front disk and the two rows 99 and 100 being arranged on opposite sides of the rear disk 96.

In the rear of the chime drum is arranged a striking disk 101 which is provided on its front side with an annular row of ten striking pins or tappets 201, and which is capable of sliding on the main shaft 56, but is always compelled to turn therewith for which purpose the hub of the striking disk is provided on one side of its center with a longitudinal coupling opening 102 which receives the front end of a coupling pin 103, secured at its rear end to a collar 104 on

the main shaft 56, see Fig. 7. On its front side the striking disk is provided with an annular row of tappets 201. On its rear end the hub of the chime drum is provided with an annular row of coupling openings 204 which are on a pitch line corresponding to the positions of the coupling opening 102 in the striking disk so that the chime drum can be coupled with the main shaft upon moving the chime drum backwardly whenever one of its coupling openings 204 is in line with the pin 103, at which time the latter will enter the respective opening 204 in the chime drum and couple the same with the shaft so that these members turn together, as shown in Fig. 5. In the foremost position of the drum, the same is uncoupled from the main shaft 56, as shown in Fig. 7, and at this time the chime drum is locked against turning by a locking pin 105 projecting rearwardly from the rear frame plate and engaging with a locking opening 106 in the chime drum. When this drum is moved rearwardly it is first disengaged from the locking pin 105 so that it is free and then the same is interlocked with the coupling pin 103 to connect it with the main shaft 56. The forward movement of both the chime drum and the striking disk is limited by engagement of the front side of the drum with a shoulder 107 on the locking pin 105, and this drum and the striking disk are yieldingly held in this foremost position by a spring 108 surrounding the shaft 56 between the rear side of the striking disk and the collar 104. The rearward movement of the chime drum and the striking disk is effected by means of a rock shaft 109 journaled on the rear plate of the main frame, an outer arm 110 engaging with the front side of the drum and an inner arm 111 engaging with the cam 47 on the main driving shaft.

The cam 47 is so constructed and positioned that during the first fifteen minutes of the hour the same shifts the chime drum backwardly into engagement with the coupling pin 103 so as to cause the drum to turn with this shaft. As soon as the drum is turned far enough to carry its locking opening 106 out of register with the locking pin, then the salient part of the cam 47 clears the arm 111, but as the front side of the drum at this time is riding on the rear end of the locking pin 105, the drum and striking disk cannot again move forwardly under the pressure of the spring 108 until the drum has made a complete rotation and the locking opening 106 has again come into register with the pin 105. By this means the chime drum will be locked against rotation after the chiming of the four quarters at the end of each hour and during the striking of the hour. The chime drum is then again released by the cam 47 during the first quarter of the new hour. Inasmuch as the drum can be locked against turning only in one position, any accidental displacement of the drum on the driving shaft will be automatically corrected so that the drum will always start off at the same point and thus insure uniformity in the sounding of the chimes of the four quarters and the strokes of the hours.

The several annular rows of tappets on the chiming drum and striking disk are adapted to engage successively with the upper arms of trip or bell levers 112, 113, 114, 115, 116 respectively, which are mounted to turn about a longitudinal horizontal rod 117. The lower arms of the bell or trip levers 112, 113, 114 and 115 associated with the tappets of the chime drum are provided with pins 118 engaging with the upper arms of elbow shaped hammer levers 119, 120, 121, 122 which are pivoted co-axially on a horizontal longitudinal rod 123, each of which has its lower arm connected by a hammer rod 124 with a hammer head 125 which is adapted to strike a bell rod 126 so as to produce the effect of a chime or gong. Each of the bell rods is mounted at one end on a stand 127 which in turn is supported on the casing of the clock in any desired manner. As the drum rotates, the bell tappets in each of its rows turn the respective trip lever in the direction for raising the companion hammer, and as each bell tappet clears the respective trip lever, the corresponding hammer drops and delivers a blow against the bell rod below the same. The tappets of the several rows on the chime drum are so arranged that bell rods of different tones are struck in the proper sequence to produce the effect of ringing chimes in a manner well known in this art.

In order to avoid increasing the number of bell rods beyond those required for the chimes, one of the chime rods, preferably the foremost one is also utilized as the bell for striking or sounding the hours. This is accomplished by providing a yoke 128 which extends lengthwise of the several trip levers and is adapted to be engaged by a pin 129 on the lower arm of the striking trip lever, and the front end of this yoke being connected with the foremost bell hammer elbow lever, and the rear end of the yoke being pivoted on the auxiliary frame plate, as shown in Figs. 2 and 5.

During the first quarter of each hour the cam 47 pushes the chimes drum backwardly so as to become interlocked and turn with the main shaft 56 without shifting the tappets thereof beyond their respective bell trip levers, but at the same time the chime disk is moved backwardly so that its bell tappets clear the striking bell lever 116. It follows from this that the drum and striking disk will turn in unison but only the chimes levers will be tripped by the chimes tappets and cause their respective bell rods to sound while the tappets of the striking disk will

rotate idly without actuating the bell striking lever.

Immediately after the ringing of the fourth quarter of the chimes rods has been completed by the completion of a rotation of the main shaft, the chimes drum is moved forwardly and locked against further turning but the striking disk continues its rotation and as its bell tappets are now in line with the rearmost bell trip lever 116, the latter is tripped and its motion is transmitted by the yoke 128 to the foremost bell lever 119 so that the bell or gong of the latter is now sounded a number of times corresponding to the hour. After the hour has been thus struck, the rotation of the main shaft 56 ceases until the next quarter hour. At the end of first, second and third quarters of each hour only the chimes are sounded but at the end of each hour the chimes are struck first and this is followed by the striking of the hour.

The mechanism whereby the chiming and striking are effected in this manner is constructed as follows:—

The numerals 130 and 131 represent two counting gear racks which are preferably in the form of segments arranged side by side and axially in line and having teeth of ratchet form. The rack 130 is the main rack and works primarily in connection with the striking mechanism and the rack 131 is the auxiliary rack which works primarily in connection with the chime mechanism. The main rack is comparatively long and has over twelve teeth, preferably sixteen, the lower twelve 132 serving as counting teeth while the teeth 133 above the counting teeth, serve solely as lifting teeth. The auxiliary rack 131 has in excess of four teeth, preferably six in number, the lowermost four 134 of which serve as counting teeth while those teeth 135 arranged above the counting teeth 134 serve as lifting teeth. The teeth of the main rack are comparatively long and those of the auxiliary rack comparatively short. The main gear rack is provided with a snail arm 136 which rocks therewith and is provided with a gage finger 137 adapted to engage one or another of the steps of the main or striking snail 52. The auxiliary gear rack is provided with a snail arm 138, which rocks with the same and is provided with a gage finger 139 adapted to engage with one or another of the steps of the auxiliary snail 53.

At the free or upper end of the detent arm 84 the same is provided with main and auxiliary detent pawls 240, 140 see Figs. 16–19, the latter being short and adapted to engage with the teeth of the auxiliary rack and the former being long and adapted to engage with the teeth of the main rack. These pawls engage successively with the teeth of the main and auxiliary racks respectively from the upper parts to the lower parts of these racks as the same are lifted in accordance with the position of the main and auxiliary snails, and finally engage with the lower ends of these racks and hold the same in their highest or foremost position after a chiming operation has been completed at the end of the first, second and third quarters of each hour, and the chiming and striking operations have been completed at the end of each hour.

Means are provided whereby the gear racks after being released and moved backwardly in accordance with their respective snails, are again raised step by step until the same reach their highest or foremost position. The means for this purpose comprise a lifter which engages with the teeth of the gear racks. This lifter has the form of a rotary gear pinion 141 mounted on the lifting shaft 69 and provided with teeth 142, 143 adapted to engage with the teeth of the main and auxiliary gear racks respectively. As the pitch of the teeth on the main gear rack is relatively of larger diameter than the pitch of the teeth of the auxiliary gear rack, the pitch diameter of the teeth 142 of the lifting pinion engaging with the main gear rack is smaller than the pitch diameter of the teeth 143 of the lifting pinion engaging with the teeth of the auxiliary gear rack, thereby causing the auxiliary gear rack to always move slightly in advance of the main gear rack during each step of the lifting operation, and thereby easing this operation of lifting the gear racks.

As shown in Fig. 1, the detent arm 84 has dropped to its innermost position in which its pawls 240, 140 engage with the lower ends of both the main and auxiliary gear racks 130, 131 respectively, at which time the chiming and striking mechanism is at rest. The detent arm 84 is limited in its movement in this direction by engaging a stop 144 on the main frame.

Assuming that the time mechanism of the clock arrives at the first quarter past an hour, the operation of the chime mechanism will be as follows:—

Upon reaching the first quarter of an hour, the first short tooth or tappet 48 of the star wheel will engage the lug 80 of the tappet arm 79 and turn the trip arms in the direction for releasing the locking arm 71 from the locking disk 70 and moving the auxiliary detent pawl 140 far enough to disengage the same from the lower end of the auxiliary counting gear rack 131 but not far enough to disengage the pawl 240 from the lower end of the main counting gear rack, thereby permitting the auxiliary counting rack to drop until its gage finger 139 engages the highest face of the auxiliary or chime snail and also permitting the main shaft 56 and the lifting pinion 141 to turn. The instant this occurs, the chime drum will be turned far enough to produce four strokes on the bell or chime rods and then be stopped by the stop arm 71 engaging

with the next notch 73 of the locking disk 70. The stop arm 71 is permitted to thus engage this locking disk due to the fact that the lifter 141 during its first half rotation upon being released engages one of its auxiliary lifting teeth or pins 143 with an adjacent tooth of the auxiliary counting rack and raises the latter one space, tooth or step so that the detent pawl 140 can again drop fully back into engagement with the lower end of the auxiliary rack and prevent the latter from falling back when the lifter is disengaged from the auxiliary rack. As the detent arm 84 moves back fully and engages its pawl with the lower end of the auxiliary rack, the detent arm also permits the weight 90 to turn the intermediate levers 86, 88, in the direction for permitting the cam arm 87 to swing back and cause its cam slot 89 to lower the lifting wire 75 and the locking arm 71 to drop its finger 72 into the next notch 73 of the locking disk, thereby arresting the operation of the chime mechanism after the same has sounded the chimes but once. While the lifter is turning and engaging the adja cent tooth of the auxiliary rack for raising the same one step, one of the main pins 142 of the lifter also engages the adjacent tooth of the main rack and lifts the same, but as the main detent pawl 240 only engages the lower end of the main rack at this time—the latter is raised idly and simply drops back into its normal position after the lifter lets go of it. This idle motion is imparted to the main rack during all subsequent operations on the same by the lifter whenever the main rack is in its highest position and the lifter is acting on the auxiliary rack for raising the same.

At the end of the second quarter hour or half hour the second tappet 49 of the star wheel again releases the locking arm 71 from the locking disk 70 and the detent pawl 140 from the lower end of the auxiliary rack, and permits the latter to drop two steps because the gage finger 139 at this time is arrested by the second highest face of the auxiliary snail. It therefore requires two operations of the teeth or pins 143 of the lifter on the teeth of the auxiliary rack for raising the latter two steps before the same has been again returned to its highest or home position where the auxiliary detent pawl 140 can again drop back fully into engagement with the lower end of the auxiliary gear rack and stop the operation of the train of gearing forming part of the bell mechanism. As the auxiliary rack is raised a step the detent arm is moved outwardly sufficiently by the tooth of the auxiliary rack engaging with the auxiliary pawl 140 but the latter engages underneath each succeeding tooth of the auxiliary rack as the latter is raised step by step, during the turning of the lifter 141 and therefore acts like a detent ratchet to hold the auxiliary rack at the end of every upward step which is gained.

While this gearing is thus in operation for two steps of the auxiliary counting rack, the chime drum is turned two steps and causes the chime or bell rods to sound the first and second quarters or the half of the hour and then come to rest.

In like manner the bell gearing will be released by the third short tappet 50, at the end of the third quarter of the hour and the auxiliary counting rack will be permitted to drop three spaces by engagement of its gage finger 139 with the third highest face of the auxiliary snail, thereby necessitating three lifting steps or operations of the lifter 141 on the auxiliary rack before the latter is again restored to its normal or home position in which the detent pawl 140 again engages fully with its lower end and the operation of the bell mechanism has been arrested. During these three lifting steps on the auxiliary rack, the chime drum turns three steps and causes the chimes to sound thrice denoting the third quarter of the hour and then stops.

At the end of the first hour the long fourth tooth or tappet 51 of the star wheel engages the lug 80 of the tappet arm 79 and turns the trip arms a greater extent than that which is effected by the short teeth 48, 49, 50 thereby releasing the train of bell operating gearing and moving not only the auxiliary detent pawl 140 from underneath the auxiliary counting rack but also moving the main detent pawl 240 from underneath the main counting rack, as shown in Figs. 3 and 19. When this occurs the auxiliary rack drops four spaces until its gage finger 139 engages with the lowest quarter face of the auxiliary snail which is moved into this position by the time mechanism, and the main counting rack drops one step, its downward movement being arrested at this time by engagement of its gage finger 137 with the highest of the twelve faces on the main snail which is turned into this position by the time mechanism.

After the detent pawls 140 and 240 have been thus disengaged from the auxiliary and main racks by the long tooth 51 of the star wheel and this tooth again clears the tappet arm 79 of the "trip arms" during its continued rotation, the detent arm 84 moves forwardly or inwardly but now only engages its main pawl 240 with the teeth of the main rack while the auxiliary pawl 140 is held out of engagement with the teeth of the auxiliary rack, as shown in Fig. 18. As the lifter now turns with the bell mechanism, the first tooth 142 engaging with the teeth of the main rack raises the same one space and then the main detent pawl 240 passes underneath the lower end of this rack and holds it in its highest position. While the lifter is thus operating on the main rack, the same does not operate on the auxiliary rack because the teeth of the

auxiliary rack and the auxiliary pawl 140 are too short to permit of engagement for this purpose, as shown in Fig. 18, and the auxiliary rack therefore remains at rest in its lowermost position while the main rack is being raised by the lifter and held by the main pawl 240. While the main gear rack is being lifted by the lifting pinion or wheel, the latter also operates on the teeth of the auxiliary rack and raises the same but since the auxiliary pawl 140 does not engage the auxiliary rack at this time, this movement of the latter is idle and the same drops back after each lifting operation. The instant however, that the main rack has reached its highest position and the main pawl has moved fully in its innermost position underneath the main rack, then the auxiliary pawl 140 is permitted to engage with the teeth of the auxiliary rack, as shown in Fig. 17. As the lifter now raises the auxiliary rack, the same is caught at the end of each step by the detent pawl 140 and prevented from falling back and after the same has been raised four steps to its highest position, the detent arm moves forwardly into its foremost position in which both the main and auxiliary pawls 240, 140 engage with the lower ends of the main and auxiliary racks. During the one step which the main rack is being raised, the bell mechanism operates to chime the first quarter, during the first upward step of the auxiliary rack the chimes are operated for the second quarter, during the second upward step of the auxiliary rack the chimes are operated for the third quarter, during the third upward step of the auxiliary rack the chimes are operated for the fourth quarter, and during the last or fourth upward step of the auxiliary rack the striking mechanism is operated to strike "one o'clock." For this purpose the timing, chiming and striking mechanisms are so timed that the timing drum remains coupled with the main shaft 56 from a period in advance of the first quarter until the end of the hour so as to chime each of the four quarters and immediately after the fourth chime at the end of the hour has been completed, the opening 106 in the drum registers with the pin 105, thereby causing the drum to be uncoupled from the shaft 56 and discontinue the chimes and then bringing the striking disk into its forward position, whereby the same can strike the hour.

After the clock strikes "one" and some time before reaching quarter after "one", the constantly rotating cam 47 pushes the chime drum and striking disk backward from the position shown in Fig. 7 to a position shown in Fig. 5, whereby the chime drum is coupled with the main shaft 56 but the striking disk is moved out of operative relation to the striking lever 116. The result is that at the end of the first quarter of the hour the chimes will be sounded due to rotation of the chime drum but no hour will be struck.

Immediately after the chime drum has commenced its hourly rotation the locking opening of the drum passes out of register with the locking pin 105 and then the shifting lever 111 drops off from the cam 47 but the drum still remains in its rearmost position because it is held back by the drum riding on the rear end of the pin 105 until the four quarters of the hour have been completed, and then the drum is again pressed forward by the spring 108 to lock the same against turning and bring the striking disk into position for operating the striking lever 116, as shown in Fig. 7. The operation of chiming the first, second and third quarters of each hour are repeated continuously in the manner just described with reference to the chiming, before the striking of "one o'clock."

When the clock reaches two o'clock, the long tappet 51 again turns the detent arm 84 outwardly its full extent so as to permit both the main and auxiliary counting racks to drop, the auxiliary rack dropping four steps as is usual at the end of each hour, but the main rack dropping two steps, inasmuch as the main snail at this time presents its next lower face to the gage finger 137 of the main rack. As the lifter 141 begins to turn, the pins 142 of the same successively engage the teeth of the main rack and lift the same two successive steps to its highest position where it is held by the main detent pawl 240, and then the auxiliary rack is raised four steps to its highest position and held there by the auxiliary detent pawl 140. The two upward steps of the main rack and the first two upward or return steps of the auxiliary rack are used for counting the four quarter chime actions, and the last two upward steps of the auxiliary rack are used for counting the two strokes representing "two o'clock."

As the time reaches three o'clock the auxiliary rack drops four steps and the main rack drops three steps, and subsequently the main rack is first lifted three steps to its home position and then the auxiliary rack is lifted to its home position. During this lifting operation, the three upward steps of the main rack and the first upward step of the auxiliary rack are utilized for operating the four quarters of the chimes, and the remaining three upward steps of the auxiliary rack are utilized for operating the striking mechanism three times.

Upon arriving at four o'clock the auxiliary rack drops four steps and the main rack also drops four steps. The lifting mechanism now first lifts the main rack four steps and then lifts the auxiliary rack four steps. The four return steps in this instance are utilized to count the four actions of the chime mechanism for the several quarters, and the four return steps of the auxiliary rack are

utilized to count the four actions of the mechanism which strikes four o'clock.

At the end of the fifth hour the auxiliary rack drops four steps on to the lowest face of the snail and the main rack drops five steps on to the fifth face of the main snail. As the main and auxiliary racks are successively raised step by step thereafter, the first four upward or return steps of the main rack are utilized for counting the four chiming actions corresponding to the four quarters of the hour, and the fifth or last upward step of the main rack and the four upward or return steps of the auxiliary rack are utilized to count the five striking actions corresponding to "five o'clock."

At the completion of each additional hour the main counting rack drops one step further and therefore has to be lifted a correspondingly increased number of steps in order to return the same to its home position by means of the lifter, but the auxiliary rack at the end of each hour always drops four steps representing the four chiming operations at the four quarters of the hour. As the main rack progressively increases the extent of its drop and therefore also increases the extent of its return movement in the same measure, the first four lifting steps of the main rack are always taken out to operate the four quarters of the chime mechanism and the remaining lifting steps of the main rack are added to the four lifting steps of the auxiliary rack to complete the counts required for striking a particular hour. In other words, when the time is four o'clock or more, then the four counts taken off from the advancing end of the main rack for operating the chiming mechanism are always added by the auxiliary rack to the trailing end of the main rack so that the combined count equals the four chime operations and the strokes of the particular hour. It is only when the time of the hour is below four o'clock that the four chiming steps are counted, partly on the main rack and partly on the auxiliary rack, as previously described. At all other hours the chiming is always counted wholly on the main rack and the striking is counted partly on the main rack and then finished on the auxiliary rack.

In Fig. 1 the main and auxiliary racks are both raised to their highest position, the main snail stands in a position in which the same presents its ninth space to the main gage finger 137 and therefore would cause the striking mechanism to announce "nine o'clock," and the auxiliary snail is in the position for arresting the auxiliary gage finger so that the chimes will play the first quarter.

Figure 3 shows the main rack dropped to the twelve o'clock striking position on the main snail, and the auxiliary rack dropped to the first quarter chiming position on the auxiliary snail.

The parts are shown in Fig. 14 in the position in which the auxiliary rack has been dropped to the four quarter chiming position on the lowest face of the auxiliary snail, and the main rack has been dropped to the seven o'clock striking position on the main snail, but has already been raised six steps, four of which were used for the four chime quarters, and two for striking, leaving one more on the main rack and four on the auxiliary rack for striking seven o'clock.

In Fig. 15 the parts are shown in the position in which the auxiliary rack has been dropped to the four quarter chiming position on the auxiliary snail, and the main snail is shown in a position in which it has previously permitted the main rack to drop to the twelve o'clock striking position, but the lifter has already lifted the main rack five steps, of which four were utilized to count the four quarter actions of the chiming mechanism and the fifth served to count the first stroke of twelve o'clock, leaving the remaining seven steps on the main rack and the four steps on the auxiliary rack to complete the remaining eleven counts for twelve o'clock.

From the foregoing description in connection with the accompanying drawings it will now be apparent that this invention provides a four quarter chiming and hourly striking clock in which the same motor, such as a spring or the like, serves to operate both the chiming mechanism and the striking mechanism.

By this means the cost of a clock which chimes the four quarters of each hour and strikes each hour, is materially reduced. Moreover the cost of manufacturing the clock and the expense of repairing the same is lessened. Furthermore this clock is more compact and as the same requires winding of but two springs instead of three, the same can be taken care of more easily. If desired a separate striking bell rod 226 may be employed which is struck by a separate bell hammer, having a hammer head 225 and a rod 224 connecting the same with the pivoted yoke 128 which is operated by the bell lever 116 of the striking mechanism as shown by dotted lines in Fig. 13, but in such modified construction—the longitudinal bar of the yoke 128 is not connected with the foremost chiming bell lever 119.

Although the construction herein shown is a practical embodiment of my invention it is to be understood that the same may be varied in the details of its construction, and the arrangement of its parts without departing from the essential features of the invention and it is therefore assumed that obvious modifications are comprehended in the appended claims.

I claim as my invention:

1. A clock comprising a time mechanism, a main driving shaft, a chiming mechanism in-

cluding a tappet drum slidably mounted on said shaft, a striking mechanism including a tappet disk slidably mounted on said shaft, a driving motor operatively connected with said driving shaft, a stop device which controls the motion of said shaft and which is operated by said time mechanism, means which operate in synchronism with the time mechanism for moving said drum and disk lengthwise on said shaft and render either said drum or said disk operative or inoperative, and means whereby in one position said drum and disk are both coupled with said shaft and in another position said drum is uncoupled from said shaft and held against turning.

2. A clock comprising a time mechanism, a main driving shaft, a motor for turning said shaft, a stop mechanism for said shaft controlled by said time mechanism, a chiming mechanism having a tappet drum mounted on said shaft so as to slide lengthwise thereon, a striking mechanism having a tappet disk slidable lengthwise on said shaft, means for moving said drum and disk on said shaft in one direction which are actuated by said timing mechanism, spring means for moving said drum and disk lengthwise on said shaft in the opposite direction, means for coupling said drum and disk in one position on said shaft and uncoupling the same in another position on the same, and means for holding drum against turning when uncoupled from said disk.

3. A clock comprising a time mechanism, a main driving shaft, a motor for turning said shaft, a stop mechanism for said shaft controlled by said time mechanism, a chiming mechanism having a tappet drum mounted on said shaft so as to slide lengthwise thereon, a striking mechanism having a tappet disk slidable lengthwise on said shaft, means for moving said drum and disk on said shaft in one direction which are actuated by said timing mechanism comprising a cam rotating with said timing mechanism, and a pair of connected lock arms engaging respectively with said cam and said tappet drum; spring means for moving said drum and disk lengthwise on said shaft in the opposite direction; means for coupling said drum and disk in one position on said shaft and uncoupling the same in another position on the same; and means for holding drum against turning when uncoupled from said disk.

4. A clock comprising a time mechanism, a main driving shaft, a motor for turning said shaft, a stop mechanism for said shaft controlled by said time mechanism, a chiming mechanism having a tappet drum mounted on said shaft so as to slide lengthwise thereon, a striking mechanism having a tappet disk slidable lengthwise on said shaft, means for moving said drum and disk on said shaft in one direction which are actuated by said timing mechanism, spring means for moving said drum and disk lengthwise on said shaft in the opposite direction, means for coupling said drum and disk in one position on said shaft and uncoupling the same in another position on the same, comprising a coupling pin mounted parallel with said main shaft and turning therewith, and said disk having its hub provided with a single opening which receives said coupling pin and said drum having its hub provided with an annular row of openings and one of which is adapted to receive said coupling pin; and means for holding drum against turning when uncoupled from said disk.

5. A clock comprising a time mechanism, a main driving shaft, a motor for turning said shaft, a stop mechanism for said shaft controlled by said time mechanism, a chiming mechanism having a tappet drum mounted on said shaft so as to slide lengthwise thereon, a striking mechanism having a tappet disk slidable lengthwise on said shaft, means for moving said drum and disk on said shaft in one direction which are actuated by said timing mechanism, spring means for moving said drum and disk lengthwise on said shaft in the opposite direction, means for coupling said drum and disk in one position on said shaft and uncoupling the same in another position on the same, and means for holding drum against turning when uncoupled from said disk comprising a stationary locking pin adapted to engage with the side of the drum in one position of the latter, and said drum being provided with an opening adapted to receive said locking pin in another position of the drum.

6. A clock comprising a time mechanism, a main driving shaft, a chiming mechanism having a tappet drum movable lengthwise on said shaft, a striking mechanism having a tappet disk movable lengthwise on said shaft and bell levers which correspond respectively to said tappet drum and disk, said drum remaining in operative relation to its companion bell levers in all positions of said drum lengthwise of said shaft, and said disk being adapted in one position lengthwise of the shaft to clear the companion bell lever and in another position lengthwise of the shaft to permit of operatively engaging the companion bell lever.

7. A clock comprising a time mechanism, a main driving shaft, a chiming mechanism having a tappet drum movable lengthwise on said shaft, a striking mechanism having a tappet disk movable lengthwise on said shaft, bell levers which correspond respectively to said tappet drum and disk, said drum remaining in operative relation to its companion bell levers in all positions of said drum lengthwise of said shaft, and said disk being adapted in one position lengthwise of the shaft to clear the companion bell lever

and in another position lengthwise of the shaft to permit of operatively engaging the companion bell lever, bell hammers adapted to be actuated by the bell levers associated with said drum, and means for causing the bell lever of the striking disk to operate one of the bell levers associated with the chiming drum.

8. A clock comprising a time mechanism, a main driving shaft, a chiming mechanism having a tappet drum movable lengthwise on said shaft, a striking mechanism having a tappet disk movable lengthwise on said shaft, bell levers which correspond respectively to said tappet drum and disk, said drum remaining in operative relation to its companion bell levers in all positions of said drum lengthwise of said shaft, and said disk being adapted in one position lengthwise of the shaft to clear the companion bell lever and in another position lengthwise of the shaft to permit of operatively engaging the companion bell lever, bell hammers adapted to be actuated by the bell levers associated with said drum, and means for causing the bell lever of the striking disk to operate one of the bell levers associated with the chiming drum comprising a yoke adapted to be engaged by the striking bell lever at one end of the row of levers and connecting with the bell hammer at the other end of said row and extending past the intermediate levers of said row.

9. A clock comprising a main snail, an auxiliary snail, a main counting gear rack adapted to engage different faces of said main snail, an auxiliary counting gear rack adapted to engage different faces of said auxiliary snail, detent means adapted to engage said racks, a lifter adapted to raise said gear racks, a motor for operating said lifter, a stop device for controlling the transmission of motion from said motor to said lifter, a time mechanism operatively associated with said snails, stop device and said detent, and chiming and striking means which are responsive to the actions of said auxiliary and main gear racks.

10. A clock comprising a main snail, an auxiliary snail pivoted co-axially with said main snail, a main counting gear rack adapted to engage with said main snail, an auxiliary counting gear rack adapted to engage said auxiliary snail, a detent device adapted to engage said racks, a lifter adapted to raise said racks, a motor operatively connected with said lifter, a stop device for controlling said lifter, a time mechanism operatively associated with said snails, stop device and detent device and chiming and striking means which are responsive to the actions of said auxiliary and main gear racks.

11. A clock comprising a main snail, an auxiliary snail pivoted co-axially with said main snail, a main counting gear rack adapted to engage with said main snail, an auxiliary counting gear rack adapted to engage said auxiliary snail and having its teeth arranged along side the teeth of the main gear rack, a single detent device adapted to engage both of said racks, a lifter adapted to engage both of said racks, a motor operatively connected with said lifter, a stop device for controlling said lifter, a time mechanism operatively associated with said snails, stop device and detent device, and chiming and striking means which are responsive to the actions of said auxiliary and main gear racks.

12. A clock comprising a main snail, an auxiliary snail pivoted co-axially with said main snail, a main counting gear rack adapted to engage with said main snail, an auxiliary counting gear rack adapted to engage said auxiliary snail, and having teeth which are shorter than the teeth of said main gear rack, a detent device having a long pawl adapted to engage the teeth of the main gear rack and a short pawl adapted to engage the teeth of the auxiliary rack, a lifter adapted to engage both of said racks, a motor operatively connected with said lifter, a stop device for controlling said lifter, a time mechanism operatively associated with said snails, stop device and detent device, and chiming and striking means which are responsive to the actions of said auxiliary and main racks.

13. A clock comprising a main snail, an auxiliary snail, said snails being pivoted co-axially, a main segmental counting gear rack adapted to engage said main snail, an auxiliary segmental counting gear rack adapted to engage said auxiliary rack, said gear racks being pivoted co-axially, a detent device for said racks, a lifter for said racks, a time mechanism operatively associated with said snails, detent device and stop device, and chiming and striking means responsive to the actions of said racks.

14. A clock comprising a main snail, an auxiliary snail, said snails being pivoted co-axially, a main segmental counting gear rack, adapted to engage said main snail, an auxiliary segmental counting gear rack adapted to engage said auxiliary rack, said gear racks being pivoted co-axially, a detent device for said racks, a lifter for said racks, a time mechanism operatively associated with said snails, detent device and stop device, chiming means, striking means, and means for causing the chiming means to be operated by the early actions of the main counting rack and the striking means to be operated by the later actions of the main counting rack.

15. A clock comprising a main snail, an auxiliary snail, said snails being pivoted co-axially, a main segmental counting gear rack,

adapted to engage said main snail, an auxiliary segmental counting gear rack adapted to engage said auxiliary rack, said gear racks being pivoted co-axially, a detent device for said racks, a lifter for said racks, a time mechanism operatively associated with said snails, detent device and stop device, chiming means, striking means and means for causing the chiming means to be operated by the early actions of the main counting rack and the striking means to be operated by the later actions of the main counting rack and all of the actions of the auxiliary counting rack.

16. A clock comprising a main snail, an auxiliary snail, said snails being pivoted co-axially, a main segmental counting gear rack adapted to engage said main snail, an auxiliary segmental counting gear rack adapted to engage said auxiliary rack, said gear racks being pivoted co-axially, a detent device for said racks, a lifter for said racks, a star wheel having short and long teeth adapted to engage and trip said stop device and cause said lifter to operate, a time mechanism operatively associated with said snails, detent device and star wheel, and chiming and striking means responsive to the actions of said racks.

17. A clock comprising a main snail, an auxiliary snail, said snails being pivoted co-axially, a main segmental counting gear rack adapted to engage said main snail, an auxiliary segmental counting gear rack adapted to engage said auxiliary rack, said gear racks being pivoted co-axially, a detent device for said racks, a lifter for said racks, a time mechanism operatively associated with said snails, detent device and stop device, chiming means adapted to be actuated every quarter of an hour in response to actions of said auxiliary rack, and striking means adapted to be actuated every hour in response to successive actions of said main and auxiliary racks.

18. A clock comprising a main snail, an auxiliary snail, said snails being pivoted co-axially, a main segmental counting gear rack adapted to engage said main snail, an auxiliary segmental counting gear rack adapted to engage said auxiliary rack, said gear racks being pivoted co-axially, a detent device for said racks, a lifter for said racks, a time mechanism operatively associated with said snails, detent device and stop device, chiming means adapted to be actuated every quarter of an hour in response to actions of said auxiliary rack, and striking means adapted to be actuated every hour in response to successive actions of said main and auxiliary racks, said detent device being disengaged from said auxiliary gear rack while the lifter is operating on the main rack and engaged with said auxiliary rack after the main rack has completed its return movement.

19. A clock comprising a main snail, an auxiliary snail, said snails being pivoted co-axially, a main segmental counting gear rack adapted to engage said main snail, an auxiliary segmental counting gear rack adapted to engage said auxiliary rack, said gear racks being pivoted co-axially, a detent device for said racks, a lifter for said racks, a time mechanism operatively associated with said snails, detent device and stop device, chiming means adapted to be actuated every quarter of an hour in response to actions of said auxiliary rack, and striking means adapted to be actuated every hour in response to successive actions of said main and auxiliary racks, said detent device being disengaged from said auxiliary gear rack while the lifter is operating on the main rack and engaged with said auxiliary rack after the main rack has completed its return movement, and said chiming means being coupled with said motor while the auxiliary snail is in action and said chiming means and striking means being coupled successively with said motor when said main and auxiliary rack come successively into operation.

20. A clock comprising two counting gear racks, a lifter for raising said racks, and a detent for successively holding said racks in position after every forward step of the same, under the action of said lifter.

21. A clock comprising a main rack, an auxiliary rack, an hour striking mechanism, a four quarter chimes sounding mechanism, and controlling means which are responsive to the positions of said main and auxiliary racks and whereby the steps for operating the first, second and third quarters of the chimes mechanism are controlled by the auxiliary rack, and at the end of each hour the first step of the chimes mechanism is controlled by the main rack and the final step of the striking mechanism is controlled by the auxiliary rack.

22. A clock comprising a main rack, an auxiliary rack, an hour striking mechanism, a four quarter chimes sounding mechanism, and controlling means which are responsive to the positions of said main and auxiliary racks and whereby the steps for operating the first, second and third quarters of the chimes mechanism are controlled by the auxiliary rack, and at the end of each hour the first step of the chimes mechanism is controlled by the main rack and the final step of the striking mechanism is controlled by the auxiliary rack, and the balance of the quarter chimes steps are, at times, controlled wholly by the main rack, and at other times partly by the main rack and partly by the auxiliary rack.

23. A clock comprising a main rack, an auxiliary rack, an hour striking mechanism, a four quarter chimes sounding mechanism, and means for controlling said striking mechanism and chimes mechanism which are responsive to the positions of said racks whereby the steps for operating the chimes

mechanism for the first, second and third quarters preceding each hour are controlled solely by the auxiliary rack; and the first chime steps at the end of the first, second and third hours are controlled by the main rack and the remaining chimes steps and the hour steps are controlled by the auxiliary rack; and whereby in operating the chimes and striking mechanisms at the end of the fourth hour all of the chimes steps are controlled by the main rack and all of the striking steps are controlled by the auxiliary rack; and in operating the chimes and striking mechanisms at the end of the remaining hours the chimes steps are first controlled by the main rack, then part of the striking steps are controlled by the main rack and the last four of the striking steps are controlled by the auxiliary rack.

24. A clock comprising a main rack, an auxiliary rack, an hour striking mechanism, a four quarters chimes sounding mechanism, and controlling means responsive to the positions of said main and auxiliary racks for operating said four quarter chimes sounding mechanism and hour striking mechanism, said controlling means being constructed to operate the chimes sounding mechanism for the first, second and third quarters of each hour in accordance with the auxiliary rack, and to operate the hour striking mechanism for some of the hours solely in accordance with the auxiliary rack and for other hours partly in accordance with the main rack and partly in accordance with the auxiliary rack.

25. A clock comprising a main rack, an auxiliary rack, an hour striking mechanism, a four quarters chimes sounding mechanism, controlling means responsive to the positions of said main and auxiliary racks for operating said four quarter chimes sounding mechanism and hour striking mechanism, said controlling means being constructed to operate the chimes sounding mechanism for the first, second and third quarters of each hour in accordance with the auxiliary rack, and to operate the hour striking mechanism for some of the hours solely in accordance with the auxiliary rack and for other hours partly in accordance with the main rack and partly in accordance with the auxiliary rack, a driving mechanism, and automatic means for coupling said four quarter chimes sounding mechanism with said driving mechanism after the operation of the striking mechanism, and for uncoupling said four quarter chimes sounding mechanism from said driving mechanism and coupling said hour striking mechanism with said driving mechanism after operation of the fourth quarter of said chimes sounding mechanism.

26. A clock comprising a main rack, an auxiliary rack, an hour striking mechanism, a four quarter chimes sounding mechanism means for controlling said striking mechanism and chimes mechanism which are responsive to the positions of said racks whereby the steps for operating the chimes mechanism for the first, second and third quarters preceding each hour are controlled solely by the auxiliary rack, and the first chime steps at the end of the first, second and third hours are controlled by the main track and the remaining chimes steps and the hour steps are controlled by the auxiliary rack and whereby in operating the chimes and striking mechanisms at the end of the fourth hour all of the chimes steps are controlled by the main rack and all of the striking steps are controlled by the auxiliary rack, and in operating the chimes and striking mechanisms at the end of the remaining hours the chimes steps are first controlled by the main rack, then part of the striking steps are controlled by the main rack and the last four of the striking steps are controlled by the auxiliary rack, a driving mechanism, and automatic means for coupling said four quarter chimes sounding mechanism with said driving mechanism after the operation of the striking mechanism, and for uncoupling said four quarter chimes sounding mechanism from said driving mechanism and coupling said hour striking mechanism with said driving mechanism after operation of the fourth quarter of said chimes sounding mechanism.

In testimony whereof I hereby affix my signature.

SAMUEL MAZUR.

Dec. 22, 1931. S. MAZUR 1,837,462

CLOCK

Filed May 10, 1926 5 Sheets-Sheet 1

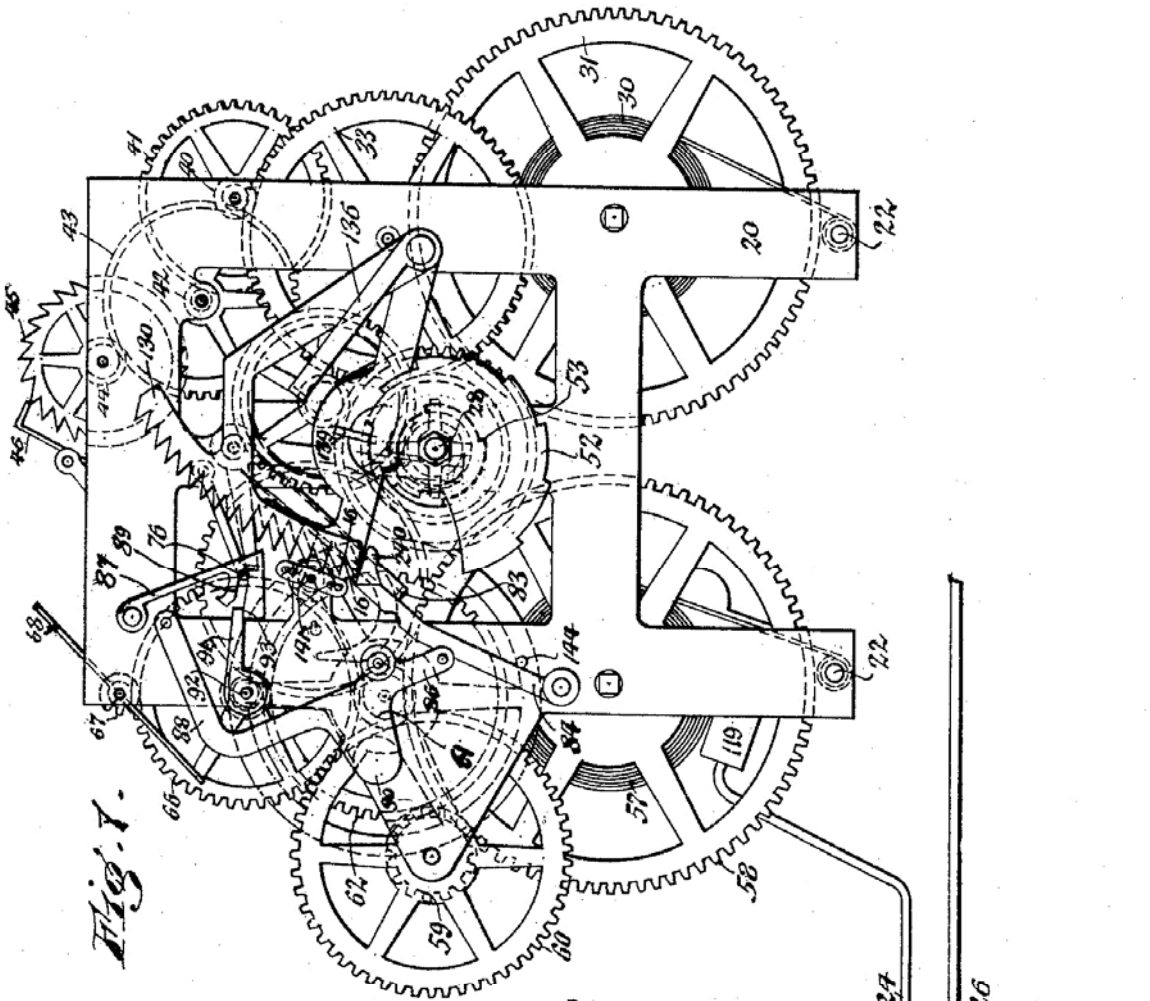


Fig. 1.

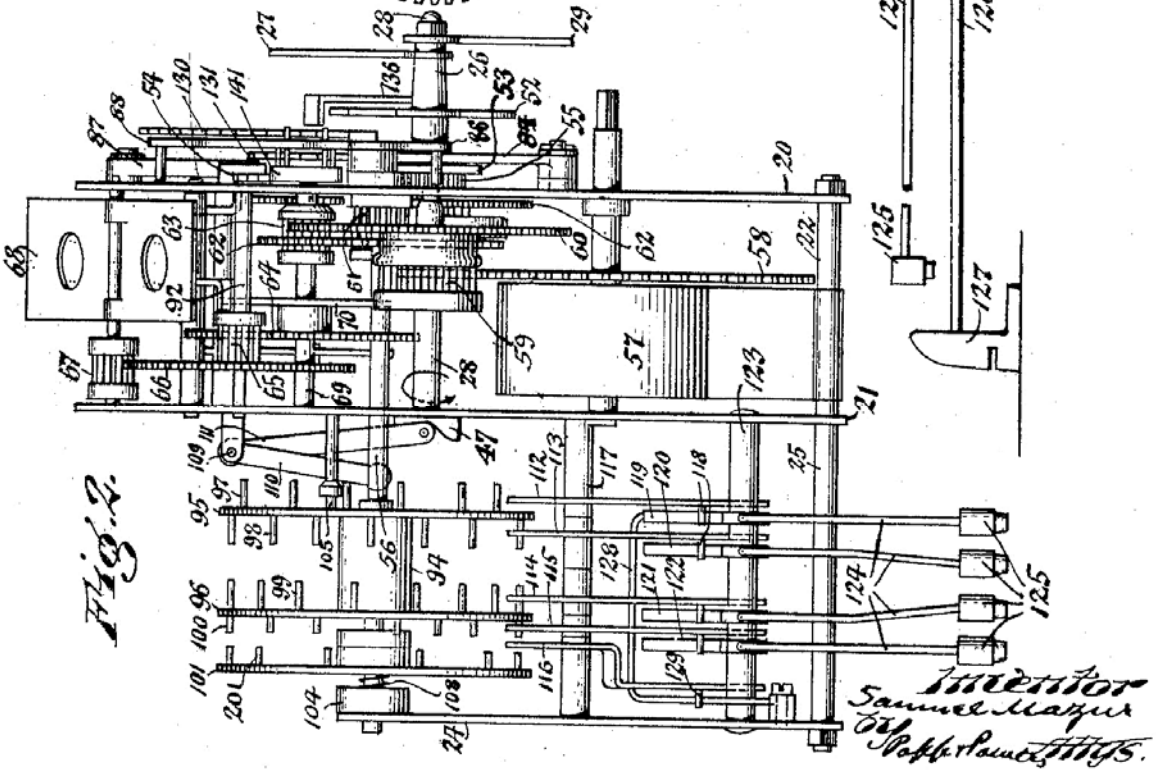


Fig. 2.

Inventor
Samuel Mazur
By Robert Lamb & Mays.

Dec. 22, 1931. S. MAZUR 1,837,462

CLOCK

Filed May 10, 1926 5 Sheets-Sheet 2

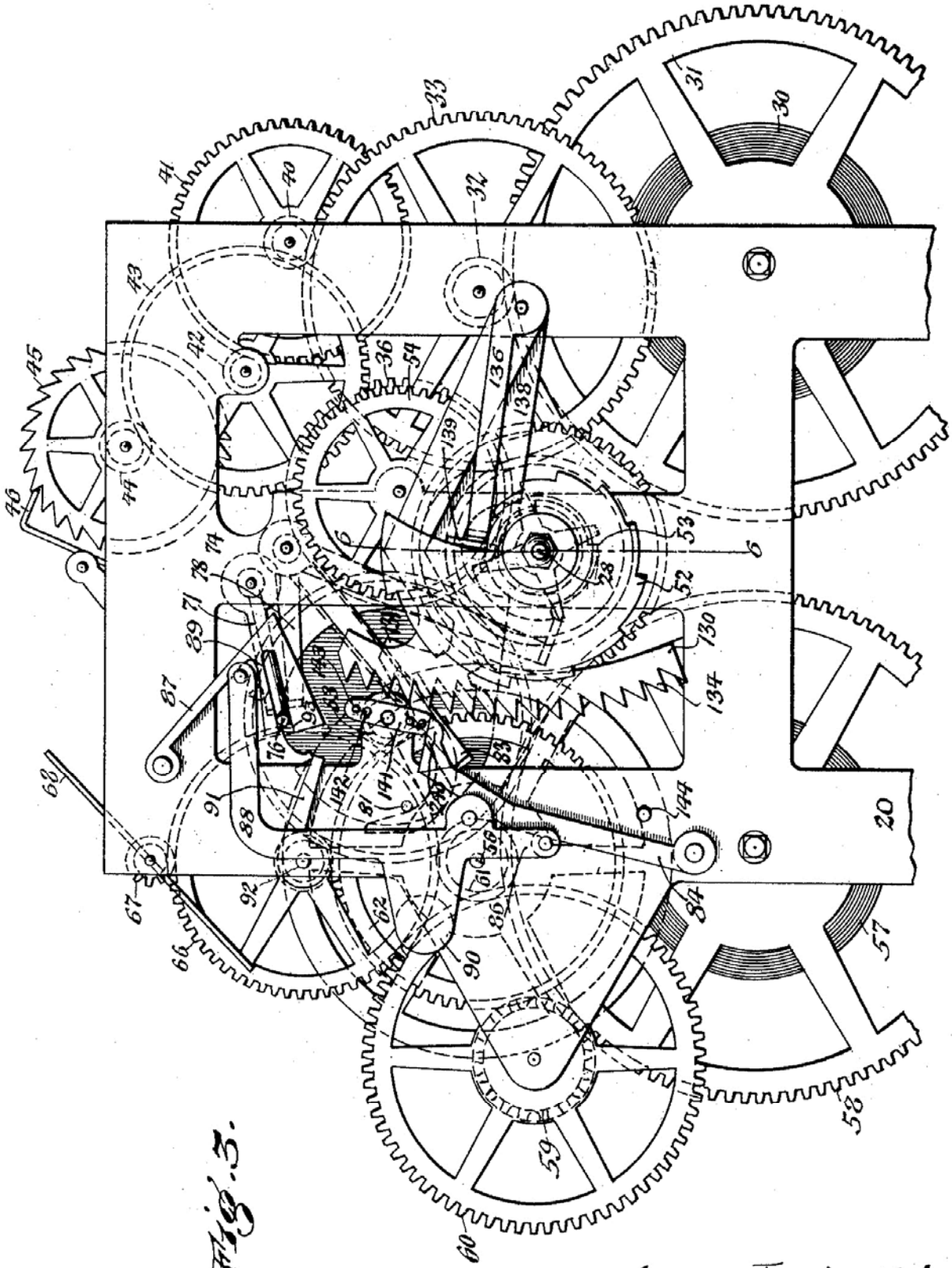


Fig. 3.

Inventor
Samuel Mazur
By Popper Bowers
Attys.

Dec. 22, 1931. S. MAZUR 1,837,462

CLOCK

Filed May 10, 1926 5 Sheets-Sheet 3

Fig. 5.

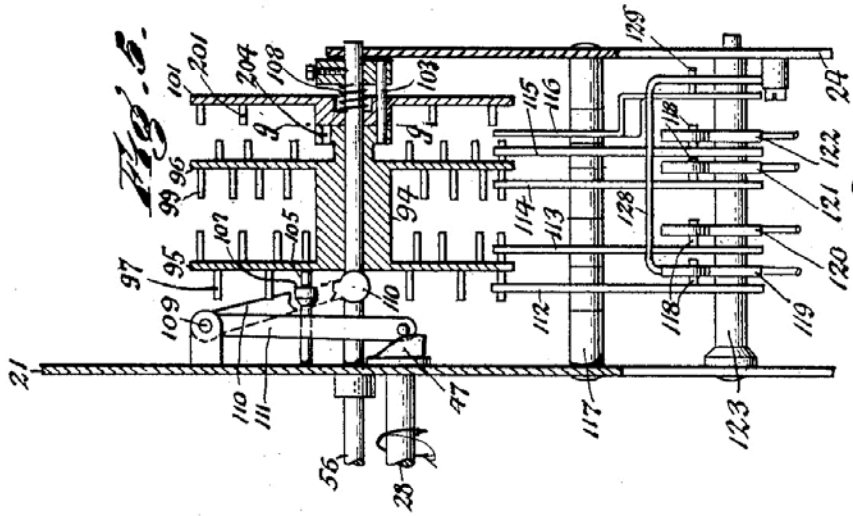
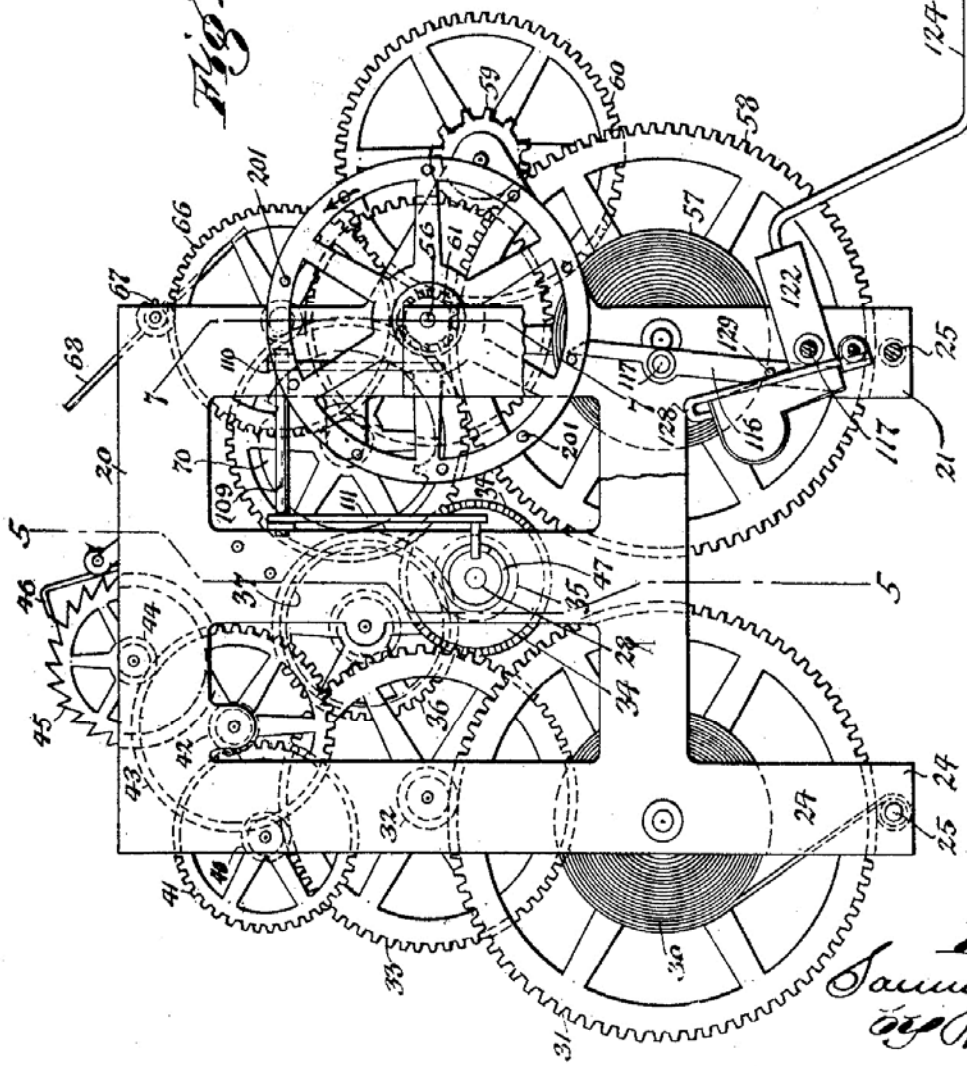


Fig. 4.



Inventor
Samuel Mazur
by Pope & Powers
Attys.

Dec. 22, 1931. S. MAZUR 1,837,462

CLOCK

Filed May 10, 1926 5 Sheets-Sheet 4

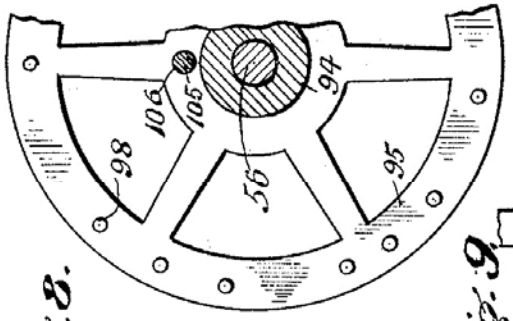


Fig. 8.

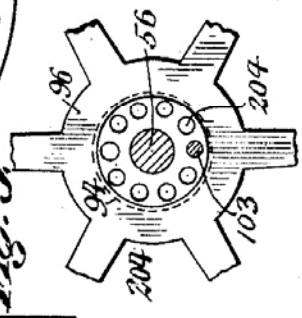


Fig. 9.

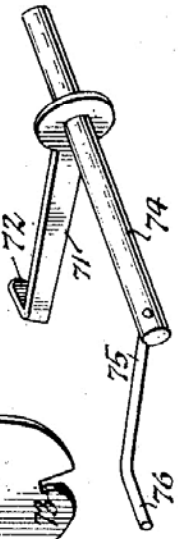


Fig. 12.

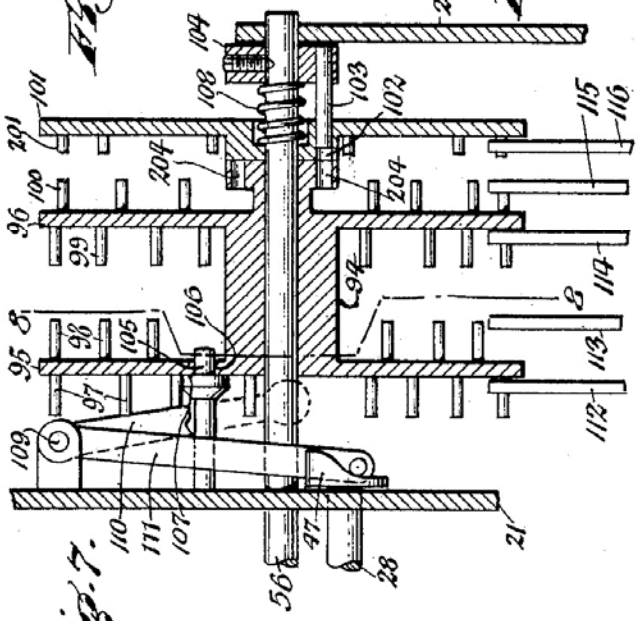


Fig. 7.

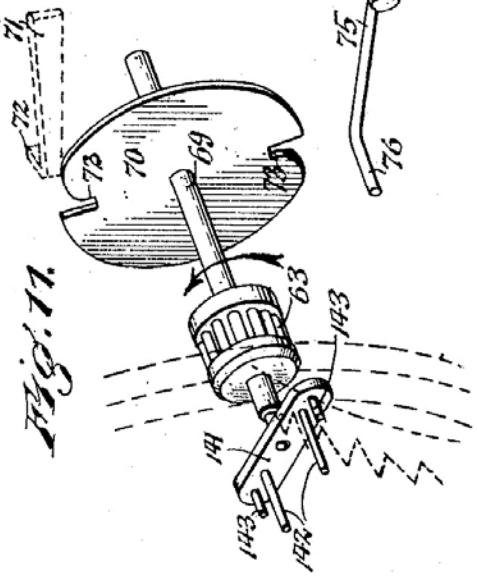


Fig. 11.

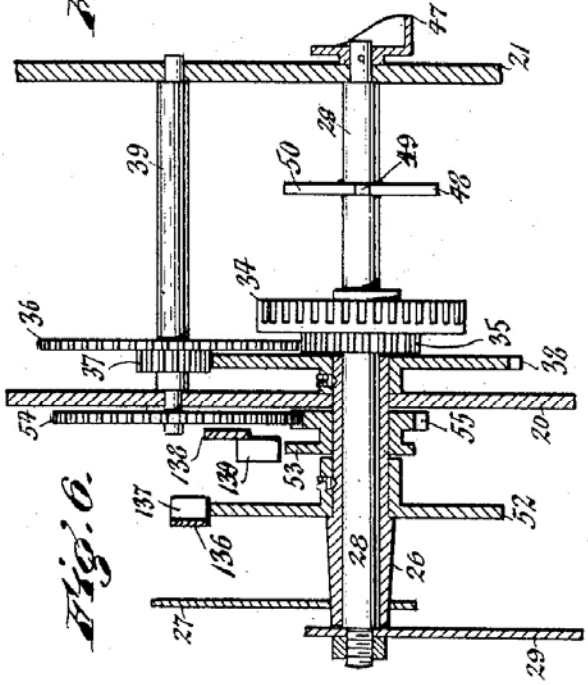


Fig. 6.

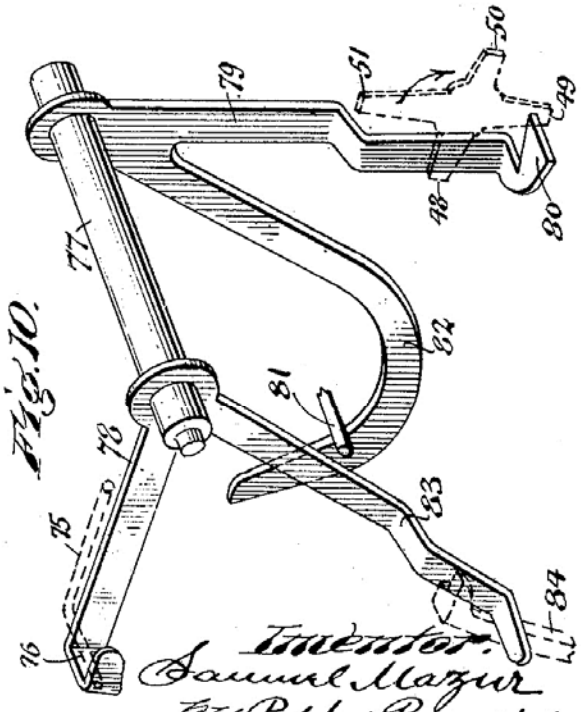


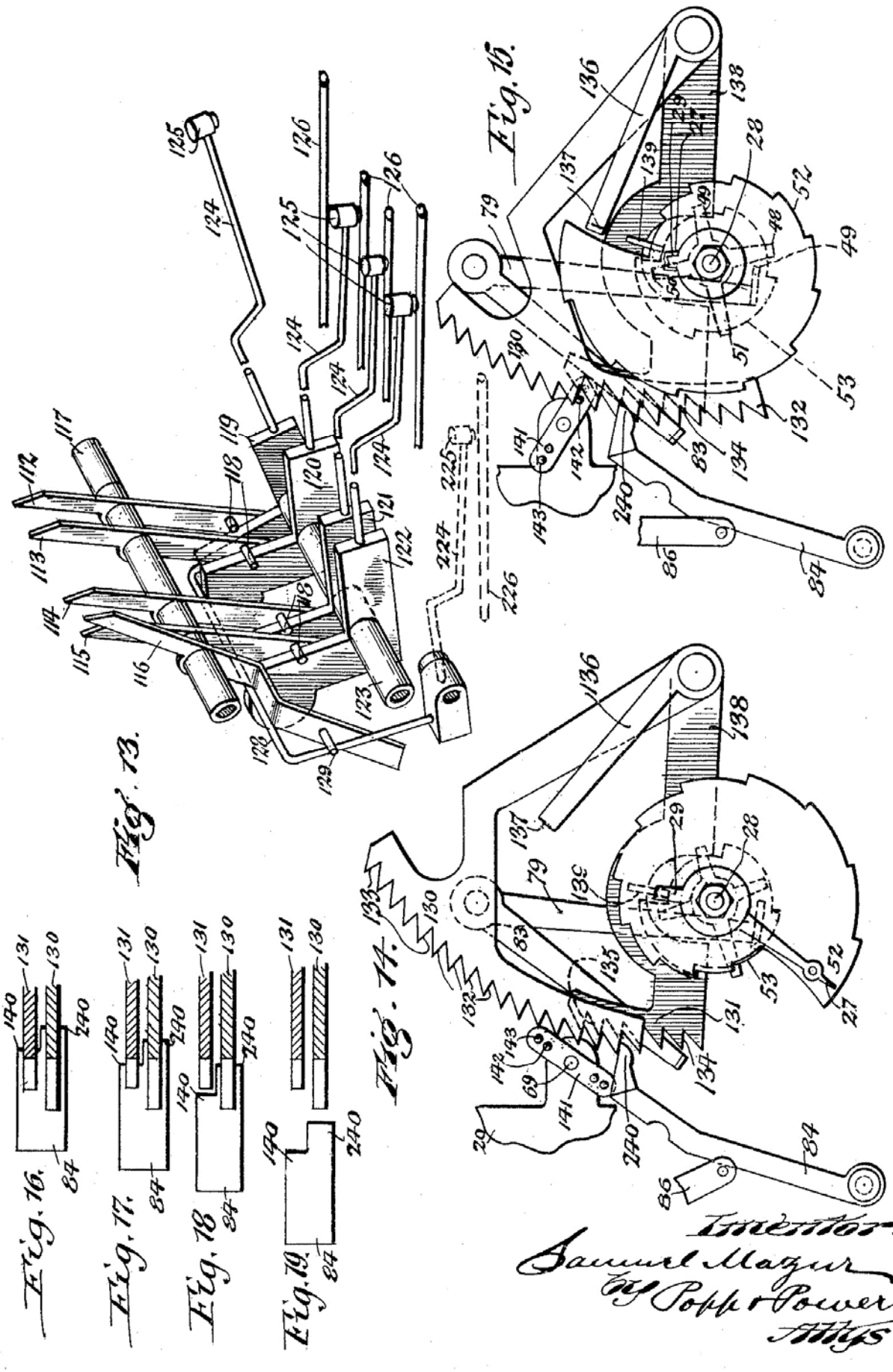
Fig. 10.

Inventor.
Samuel Mazur
by Popp & Powers
Attys.

Dec. 22, 1931. S. MAZUR 1,837,462

CLOCK

Filed May 10, 1926 5 Sheets-Sheet 5



Inventor.
Samuel Mazur
By Popp & Powers
Attys.

Patented Oct. 18, 1932 1,883,387

UNITED STATES PATENT OFFICE

SAMUEL MAZUR, OF BRISTOL, CONNECTICUT, ASSIGNOR TO THE SESSIONS CLOCK COMPANY, OF FORESTVILLE, CONNECTICUT, A CORPORATION OF CONNECTICUT

CHIME CLOCK

Application filed April 18, 1930. Serial No. 445,281.

This invention relates to a chime clock and more particularly to a clock of this type which strikes the hours and also chimes the four quarters of each hour, such as that shown in U. S. patent application, No. 108,044, filed May 10, 1926, now having become Patent No. 1,837,462, dated Dec. 22, 1931.

One of the objects of this invention is to improve the counting mechanism forming part of the means whereby the chiming and striking mechanism is operated.

Another object of this invention is to improve the means for supporting part of the train of gearing which operates the chiming and striking mechanism so as to facilitate assembling of the same and also prevent distortion and binding of the bearings on the same.

Another object is to provide improved means for driving the player wheels or disks of the chiming and striking mechanism.

A further object is to provide improved means for assembling the chiming disks as a unit or drum and holding the same against turning while the striking mechanism is in operation.

Additional objects of this invention are to improve the hammer mechanism, and various details of construction as will be fully set forth hereinafter.

In the accompanying drawings:

Fig. 1 is a fragmentary front elevation of the works of a clock embodying my improvements with the hour and minute hands omitted.

Fig. 2 is a rear elevation of the same.

Fig. 3 is a side elevation thereof.

Figs. 4 and 5 are fragmentary front elevations, partly in section, of different positions of the striking and chiming snails and associated parts of the means which control the operation of the chiming and striking mechanism.

Figs. 6, 7, 8 and 9 are cross sections taken on line 6—9, Fig. 4, showing different positions of the detent mechanism relative to the main and auxiliary counting racks.

Fig. 10 is an end view of the player wheels constituting the player drum and showing the shaft carrying the same in section.

Fig. 11 is a fragmentary cross section taken on line 11—11, Fig. 3.

Fig. 12 is a diagrammatic perspective view of the group of player wheels and mechanism adjacent thereto.

Figs. 13 and 14 are fragmentary vertical longitudinal sections taken on the correspondingly numbered lines on Fig. 2.

Fig. 15 is a horizontal section, on an enlarged scale, taken on line 15—15, Fig. 11, showing the improved means for connecting each hammer lever with its hub.

Fig. 16 is a fragmentary plan view of a portion of the clock.

Fig. 17 is a fragmentary sectional view of the chimes drum and the locking arm whereby the same is held against rotation while the hour striking mechanism is sounding.

Fig. 18 is a fragmentary horizontal section taken on line 18—18, Fig. 1.

In the following description similar characters of reference indicate like parts in the several figures of the drawings.

Although the main frame of this clock may be of any suitable construction the same, as shown in Figs. 1, 2, and 3, preferably comprises upright front and rear main plates 20, 21 which are connected with each other by horizontal bars or posts 22, two front and rear side brackets 23, 24 secured to the front and rear main frame plates and projecting laterally therefrom, a horizontal bracket bar or post 25 connecting the outer upper parts of the side brackets 23, 24, front and rear auxiliary frame bars 26, 27 arranged in rear of the rear main plate, horizontal upper and lower posts 28, 29 connecting the upper and lower ends of the frame bars, and a bolt 30 connecting the front frame bar 26 with the rear frame plate 21.

The numeral 31 represents the tubular hour shaft which carries the hour hand 32 at its front end and which is journaled in suitable bearings on the front main frame plate. Within this tubular shaft is arranged the center post or minute shaft 33 which is journaled therein and also in a bearing on the rear frame plate and which carries at its front end the minute hand 34. The power for driving the hour and minute shafts is

derived from the time motor which includes a coil spring 35 having its outer end connected with the main frame and transmitting motion from its inner end to the hour shaft by a train of gearing operating to turn the hour hand once during every twelve hours and the minute hand once during each hour, this gearing including a main gear wheel 36 operatively connected with the inner end of the time spring 35, a gear pinion 37 meshing with the winding gear wheel 36 and connected with a gear wheel 38, a gear wheel 39 secured to the minute shaft 33 and meshing with the gear wheel 38, a gear pinion 40 secured to the minute shaft 33 and meshing with a gear wheel 41, a gear pinion 42 connected with the gear wheel 41 and meshing with a gear wheel 43 on the hour shaft 31, as shown in Figs. 1, 3 and 13. The gears 41 and 42 are mounted on an intermediate shaft 44 which is journaled in bearings on the front and rear plates of the main frame, as shown in Fig. 13.

Retarding of the motion of this train of gearing is effected by the usual retarding mechanism consisting of a gear pinion 45 meshing with the intermediate gear wheel 38 and connected with a gear wheel 46, a gear pinion 47 meshing with the gear wheel 46 and connected with a gear wheel 48, a gear pinion 49 meshing with the gear wheel 48 and connected with an escapement wheel 50, and an oscillating pallet 51 engaging with the escapement wheel.

At its rear end the main or minute shaft 33 is provided with a shifting cam 52 and within the main frame this shaft is provided with a star or tappet wheel having four equidistant teeth, one of which 53 is comparatively long and the remaining three 54, being comparatively short, as shown in Figs. 1, 12 and 13.

On the tubular hour shaft 31 is arranged an hour striking or main snail 57 having twelve stops or steps arranged progressively further from the axis of this snail and corresponding to twelve hours of a day; and rotatable about the minute and hour shafts is an auxiliary or chime snail 58 which has four equidistant stop faces arranged progressively further from the axis of these shafts. These snails are operated so that the chime snail 58 turns once during each hour and the striking snail 57 turns once during every twelve hours, this being preferably accomplished by a gear wheel 59 secured to the intermediate shaft 44 and meshing with a pinion 60 secured to the chime snail 58, as shown in Fig. 13.

The numeral 61 represents the main horizontal driving shaft of the chime and striking mechanism which is journaled lengthwise in bearings on the front and rear plates of the main frame and is driven by a motor preferably including a spring 62 connected at its outer end with the main frame and a train of gearing consisting of a main gear wheel 63 operatively connected with the inner end of this spring 62 and meshing with a gear pinion 64, a gear wheel 65 connected with the pinion 64 and meshing with a gear pinion 66 on the main driving shaft 61, as shown in Figs. 1, 2 and 3. Retarding the motion of this train of gears is preferably effected by the usual brake device consisting of a gear wheel 67 connected with the main shaft 61 and meshing with a gear pinion 68, a gear wheel 69 connected with the pinion 68 and meshing with a gear pinion 70, a gear wheel 71 connected with the pinion 70 and meshing with a gear pinion 72, and a rotary fly wheel 73 connected with the pinion 72.

The bracket plates 23, 24 carry the bearings for the shaft 55 upon which the gear wheel 65 and pinion 64 are mounted, and is journaled in bearings in the outer parts of the bracket plates 23, 24, and the main shaft 61 has its central part journaled in a bearing formed in the rear main frame plate 21 and the rear bracket plate 24 while the front end of this shaft is only journaled in a bearing in the front bracket plate 23, as shown in Fig. 18. As these brackets are connected at their upper outer ends by a horizontal post 25, the latter and these brackets form a separate side frame unit on which the shafts and gear wheels and pinions just described can be readily assembled and then this side frame can be connected with the main frame and the gear wheel 65 placed in mesh with the pinion 66 on the main shaft 61, thereby facilitating assembling of the clock and reducing its cost of manufacture. The horizontal post, pillar or rod 25 prevents the plates 23, 24 of the side frame from being pressed together or spread apart, thereby avoiding cramping as well as loosening of the shaft 55 in its bearings on these plates.

The gear pinion 68 and gear wheel 69 are both mounted on the same lifting shaft 74 journaled on the main frame and forming part of the mechanism for operating the chimes and striking mechanism.

The main spring 62 at times is prevented from turning by a locking disk 75 secured to the shaft 74 and a locking arm 76 having a locking finger 77 adapted to engage either one or the other of two equidistant notches 78 in the periphery of this disk. Lifting of this locking arm 76 to permit the locking disk 75 to turn is effected by a releasing shaft 79, which carries the arm 76, a releasing arm 80 connected with the releasing shaft 79 and provided with a forwardly projecting releasing finger 81, a controlling shaft 82 provided with a tappet arm 83 adapted to be engaged by the teeth 53, 54 of the tappet or star wheel, a trip arm 84 arranged on the controlling shaft 82 and having a forwardly projecting trip finger 85, and a vertically

swinging detent arm 86 pivoted on the frame and arranged between the releasing and trip fingers 81, 85 and forming part of the counting device of the chime and hour striking mechanism as will presently appear.

At the end of every quarter hour one of the teeth of the star wheel engages with the tappet arm 83 and turns the same so as to lift the arms 84, 86, 80, thereby disengaging the locking arm 76 from the locking disk 75 preparatory to permitting the spring 62 to turn the shaft 61 and the parts geared thereto. Upon releasing the locking arm 76 from the locking wheel 75 a warning stop arm 87 on the controlling shaft 82 engages with a warning pin 88 on the gear wheel 71, whereby the gearing is only permitted to advance far enough to carry the respective notch 78 in the locking disk out of register from the locking lever 76, but when the respective tooth 53 or 54 of the star wheel clears the tappet arm 83 and the latter swings back so as to disengage the warning arm 87 from the warning pin 88 and the train of gearing associated therewith are permitted to turn forwardly the required extent. When the main shaft 61 has completed its rotary movement the locking arm 76, as will later appear, is permitted to drop and engage with the next following notch 78 in the locking disk 75 and thereby arrest the operation of the chime and striking mechanism.

The means for controlling the chime mechanism at the end of each quarter of each hour and the striking mechanism in accordance with the position of the chime and striking snails is constructed as follows:

The numerals 89 and 90 represent main and auxiliary counting racks having the form of toothed segments which are arranged side by side below the detent arm 86 and pivoted coaxially on the adjacent front plate of the main frame by a pivot 91. The main rack is comparatively long and has at least twelve teeth 92 and preferably more, of which the first twelve serve as counting teeth and the remainder serve merely as lifting teeth. The auxiliary rack has at least four teeth 93 and preferably more, of which the first four serve as counting teeth and the remainder serve as lifting teeth. In the present case the radial distance of the two counting racks is the same and the teeth of the same are of equal length, but this is not essential inasmuch as this distance and length can be varied and still permit of obtaining the advantageous results of this invention. The main counting rack 89 is provided with a snail arm 94 which is adapted to engage the steps or stops of the hour snail 57 and the auxiliary rack is provided with a snail arm 95 which is adapted to engage with the steps or stops of the quarter hour snail 58. These racks when free are turned in the direction for engaging their snail arms with the registering steps of the main and auxiliary snails, respectively, by gravity aided by means of springs 96, 97 connecting these arms with the adjacent part of the frame. The free end of the detent arm 86 is preferably arranged in a plane passing between the main and auxiliary racks and is provided on its opposite sides with detent pawls or jaws 98, 99 the former being set forward of the latter or nearer the axes of the gear racks so that when the main pawl 98 engages with an intermediate tooth of the main rack then the auxiliary pawl 99 will be held out of the path of the teeth of the auxiliary rack but after all the teeth of the main rack have passed the main pawl then the detent arm 86 can drop or move farther toward the racks and engage the auxiliary pawl 99 with the teeth of the auxiliary rack.

After the racks have been released by the detent arm and have moved forwardly by gravity and spring means, the same are again moved backwardly the same extent corresponding to the position of the respective snails. This backward movement is produced by a rotary lifting wheel 100 mounted on the front end of the lifting shaft 74 and provided with two diametrically opposite teeth or pins 101 which are adapted to engage successively with the teeth of the counting racks and return them step by step into their rearmost position.

By arranging the detent arm 86 above the counting racks and engaging the underside of the same by the trip arm 84 while the upper side of the detent arm engages the under side of the releasing arm 80, the counting mechanism is materially simplified and less power is required to operate the chiming and striking mechanism.

Arranged in the rear of the lower part of the main frame is a chime player drum consisting of four chiming wheels or player disks 102, 103, 104, 105 and a striking wheel or disk 106 arranged side by side, the chiming wheels being next to the main frame and the striking wheel being in rear of the chiming wheels. The chiming wheels are slidable lengthwise on the main shaft 61 and at times turn with said shaft and at other times are held against turning therewith. Each chiming disk or wheel is preferably made of flat metal and provided on its peripheral edge with an annular row of player pins, tappets, or teeth 107. The several chiming disks are mounted on a hub which consists of a central bushing or tube 108 upon the periphery of which three collars are mounted, a central collar 109, a front collar 110, and a rear collar 111, these collars and bushing being held together by a friction or driving fit and also by peening or upsetting slightly the front and rear ends of the bushing against the foremost and rearmost faces of said collars. The

central collar is provided at its opposite ends with annular shoulders 113 which are formed by reducing these ends and upon which the intermediate two chiming wheels 103, 104 are seated with a driving fit, and the front and rear collars 110, 111 are provided on their front and rear ends, respectively, with annular shoulders 112 upon which the front and rear chiming wheels 102, 105 are securely held by a driving fit and also by peening or upsetting the end collars 110, 111 against the end chiming disks or player wheels.

The striking disk or wheel 106 is provided with an annular row of ten equidistant striking pins, teeth or tappets 114 and is mounted by a driving fit on an annular shoulder 115 on the rear end of a tubular hub 116 slidable lengthwise on the adjacent rear part of the driving shaft 61. This construction of the disks or wheels and hub of the chimes drum and the disk and hub of the striking wheel is very simple, strong and durable and can be easily and economically manufactured.

The striking disk is always compelled to turn with the shaft 61 and at times the chimes disks are compelled to turn with the striking disk while at other times the chimes disks are held against turning therewith.

Turning of the striking disk 106 with the driving shaft 61 is effected by a driving arm or index arm 117 secured to the rear end of this shaft and provided at its outer end with a forwardly projecting chime wheel driving pin 218 of tubular form which constantly engages slidingly with a driving opening 119 in the striking disk 106 adjacent to the periphery thereof, as best shown in Figs. 12 and 14. Slidable or floating lengthwise in the chime wheel driving pin 218 is a player wheel driving pin 118 adapted to engage with one or another of a plurality of coupling or driving openings 120 in the rearmost chiming disk or player wheel 105. The chime wheel driving pin 118 is yieldingly held in its foremost position relative to the striking wheel driving pin 218 by a spring 219 arranged in rear of the driving arm 117 and secured at its inner end to the hub of the same while its outer end presses forwardly against the rear end of the chiming wheel driving pin 118. The forward movement of the latter is limited by a stop 217 having preferably the form of a disk secured to the rear end of the pin 118 and adapted to engage the rear end of the tubular driving pin 218.

In the former construction the pin 118 was rigidly attached to the index or driving arm 117 and thereby liable to cause stubbing or jamming of the mechanism if the hole 120 in the rearmost player wheel 105 did not line up exactly with the driving pin 118 when the player wheels were moved rearwardly for effecting a chiming action. With this new construction the pin 118, being yieldingly mounted, will recede if a solid part of the rearmost player wheel 105 during the rearward movement of the player wheels engages the pin 118 inasmuch as the spring 219 will give way, but when the pin 118 during its rotation with the shaft 61 comes into alinement with a hole 120 then the pin 118 will be shot forwardly into engagement therewith by the spring 219 and cause the player drum to be coupled with the shaft for producing a chiming action.

This organization therefore permits the wheels to be turned at random without liability of jamming the pin 118 because eventually a hole 120 will line up with this pin and permit the latter to shoot into the same with certainty and thus insure proper functioning of the hour striking and quarter hour chiming mechanism.

By driving the chimes drum and the striking disk or wheel adjacent to their peripheries through the medium of the driving pins 118 and 218 a greater amount of space is available for locating the coupling openings 120 in the chiming disk 105, the parts are more accessible and more easily assembled, extreme accuracy in workmanship is not required, power for driving the drums and striking wheel is applied more effectively so that a lighter spring motor can be used, and the hammers of the chimes and striking mechanism are not liable to become "hung" or "stuck" half way during the chiming or striking operation due to the lack of power applied to the chiming and striking wheel, as would be the case if the drum and striking wheels were turned by power applied adjacent to the hubs thereof. Inasmuch as the linear distance of a circumferential line becomes shorter as the radius of the same decreases any inaccuracy in the location of the coupling openings 120 are multiplied as the distance of the same from these openings to the axis of the disk 105 is reduced and it is therefore apparent that greater latitude is permitted in the formation of these openings without liability of unfavorably affecting the working of the chiming mechanism. The several disks are yieldingly held in their foremost position when free by a spring 121 surrounding the driving shaft 61 and interposed between the front side of the driving arm and the hub of the striking disk. In the foremost position of the chiming drum the same is uncoupled from the main shaft 61, as shown in Fig. 14, and at this time the drum is locked against turning by a locking pin 122 projecting rearwardly from the rear plate of the main frame and engaging with a locking opening or slot 123 in the foremost chiming disk 102. In order to permit of readily adjusting the position of the locking pin 122 to the locking opening this pin is mounted on an adjusting arm 124 which is capable of swinging transversely across the front end of the drum and has its outer end pivoted by a rivet 125 to the adjacent part of the rear plate of

the main frame. By turning this arm on its pivot the locking pin 122 can be readily and easily adjusted to the path of the locking opening 123 without requiring extreme accuracy in manufacture in order to insure engaging this opening with said pin the instant this opening and pin are in register at which time the spring 121 pushes the several disks forwardly and causes the chiming drum to be uncoupled from the shaft 61 but maintains the coupling between the striking disk and the driving shaft 61. The rivet 125 which connects the arm 124 with the main frame is preferably made sufficiently tight so that these parts will remain frictionally in their adjusted position, thereby materially simplifying the construction and reducing the cost of manufacture.

The rearward movement of the chiming drum and the striking disk is effected by a horizontal rock shaft 126 journaled transversely on the rear plate of the main frame and provided at its inner end with an inner depending cam arm 127 which engages with the cam 52 and at its outer end with a forked arm 128 which engages with the front end of the drum hub on opposite sides of the driving shaft 61. The cam 52 is so constructed that during the first quarter following each hour the same will move the chiming and striking disks rearwardly so that they are coupled by the pin 118 and held in this position long enough for the locking opening 123 to move out of register with the locking pin 122 after which the inner arm 127 drops off from this cam 52 and the imperforated rear face portion of the foremost chiming disk 102 rides on the end of the locking pin 122 until the opening 123 again presents itself at the end of a rotation and the chiming drum is again moved forwardly into a locked position by the spring 121.

After the cam arm 127 drops off from the cam 52 the same hangs by gravity in a pendant position and its movement toward the low part of this cam is limited so that it cannot engage the same by a stop 129 arranged on the rear side of the rear main frame plate which is adapted to be engaged by said cam arm 127 as shown in Fig. 14. By this means frictional engagement of the cam arm 127 with the low part of the face of the cam 52 is prevented thereby avoiding wear on these parts and also eliminating unnecessary friction which would cause a drag on the mechanism and waste some of the power of the chime and striking spring and otherwise require making the latter more powerful to properly operate the chime and striking mechanism.

Below the chimes drum and the striking wheel is arranged a set of bell rods, in the present case five in number comprising four chiming rods 130 and a striking rod 131. These rods are arranged preferably horizontally and parallel and mounted at one end on a stationary stand 132 which is supported on the clock case containing the clock mechanism. These bell rods are sounded by a hammer mechanism which is actuated by the chimes drum and the striking wheel in accordance with the present improvement which is constructed as follows:

The numeral 133 represents a lower pivot rod mounted horizontally and lengthwise on the lower part of the upright bars 26, 27 of the rear or hammer frame. Upon this pivot rod is arranged a longitudinal row of hammer hubs 134, each of which turns on this rod and is provided with an annular groove 136.

Associated with the disks of the chimes drum and striking wheel and the bell rods are five hammer levers each of which is constructed of a single piece of wire and bent to form a central semi-circular loop 137 which is seated in one half of the groove of one of the hammer hubs and is secured therein by peening or riveting the adjacent parts of the edges of this groove over the loop, as shown at 138 in Figs. 14 and 15, an L shaped lower arm 139 extending downwardly from the lower end of the loop and provided with a hammer head 140 adapted to strike one of the bell rods, and an upper arm 141 projecting upwardly from the upper end of said loop and terminating in a brake finger 142 which is adapted to yieldingly engage a hub or collar 143 on an upper horizontal longitudinal pivot rod 144 mounted on the upper parts of the hammer frame bars.

On the upper pivot rod are fulcrumed a plurality of intermediate hammer lifting levers each of which is secured to one of said hubs 143 and has a lower arm 146 provided with a laterally projecting pin 147 adapted to engage the upper arm of one of the hammer levers and an upper arm 148 having a laterally projecting pin 149 adapted to be engaged by the teeth of one of the disks of the striking wheel or chimes drum. Whenever a tooth of one of these disks, during rotation of the drum or the striking wheel, engages the upper pin 149 of a hammer lifting lever the upper arm of the latter is deflected in one direction and the lower arm in the opposite direction so that the lower pin 147 of the same, by engaging the upper arm 141 of the respective hammer lever will cause the hammer to be lifted and when the tooth of the respective disk clears said upper pin of this lifting lever the respective hammer drops into engagement with the companion bell rod and sounds the same. As the hammer hits the bell rod the brake finger 142 on the upper arm of the respective hammer lever strikes the adjacent collar or hub 143 and is yieldingly arrested so that the hammer strikes the bell rod with a springing blow, and as the lifting lever drops back into

its normal position the same engages a rubber bumper 150 having the form of a sleeve mounted on a horizontal rod 151 which is supported lengthwise on the bars 26, 27 of the sounding frame, as shown in Figs. 3, 11 and 14.

In this hammer mechanism each hammer lever is made from a single piece of wire and no counter weights are employed, thereby simplifying the construction, and enabling a better blow against the bell rods to be obtained. Due to the use of side pins 147, 149 on the upper and lower arms of the intermediate levers an easier sliding action of the same on the hammer levers is secured.

The operation of this clock is fully described in the pending application above referred to and the following brief review of the same will therefore answer present requirements:

As shown in Figs. 1 and 6 the detent arm 86 has dropped into its innermost position in which its pawls or jaws 98, 99 engage with the front ends of the main and auxiliary gear or counting racks 89, 90 at which time the chiming and striking mechanism is at rest. The descent of the detent arm at this time is limited by engagement of the main pawl 98 with an upwardly facing shoulder 152 on the front end of the main counting rack.

Upon reaching the first quarter of an hour the first short tooth or tappet 54 of the star wheel will engage the tappet arm 83 and lift the arms 83, 84, 80, and 76 so as to release the locking arm 76 from the locking disk 75 and also lifting the detent arm 86 far enough to disengage the auxiliary counting pawl 99 from the front end of the auxiliary counting rack 90 but not far enough to disengage the main counting pawl 98 from the front end of the main counting rack 89, as shown in Fig. 8, thereby permitting the auxiliary counting rack 90 to move forwardly under the action of its spring 97 until its gage finger 95 engages the highest face or step of the auxiliary or chiming snail 58, and also permitting the main shaft 61 and the lifting wheel 100 to turn. The instant this occurs the chime drum will turn far enough to produce four strokes on the respective bell rods and then be arrested by the locking arm 76 engaging with the next notch 78 of the locking disk 75. While thus released the lifting wheel 100 makes a half turn and one of its pins 101 engages one of the adjacent teeth of the auxiliary counting rack 90 and moves the same backwardly one tooth, space or step so that the auxiliary detent pawl 99 can again drop into engagement with the front end of this rack. Dropping of the detent arm so that its auxiliary pawl 99 engages with the front end of the auxiliary counting rack also permits the locking arm 76 to drop into the next notch 78 in the disk 75 and stop its rotation, thereby arresting the operation of the chiming mechanism after the same has sounded the chimes but once.

At the end of the second and third quarter hours the second and third tappets 54 of the star wheel release the locking arm 76 from the locking disk 75 and permit the auxiliary counting rack to move forwardly two and three steps in accordance with the second and third higher steps of the auxiliary snail but still holding the main rack in its rearmost position, whereupon the chimes are sounded twice and thrice, respectively, and the auxiliary counting rack is moved step by step back into its rearward position and then the chiming mechanism is stopped. After each backward step of the auxiliary rack 90 due to the rotation of the lifting wheel 100 the pawl 99 engages with the adjacent tooth 93 of the auxiliary counting rack, as shown in Fig. 7 and prevents the same from moving forward while the lifting wheel is out of engagement with this rack.

At the end of the first hour the fourth or long tooth 53 of the star wheel turns the arms 76, 86, 84, and 80 a greater extent so as to first operate the chiming mechanism for sounding the chime rods four times and then operate the striking mechanism for sounding the striking rod once. When the detent arm 86 is raised at this time both the main pawl 98 and the auxiliary pawl 99 are moved out of the path of the main and auxiliary counting racks 89, 90, as shown in Fig. 9, thereby permitting the auxiliary rack to move forwardly four spaces or teeth and the main rack to move forwardly one space or tooth in accordance with the position of the auxiliary and main snails at this time. After the counting racks have been thus moved forwardly the detent arm 86 drops and engages its main pawl 98 with the main rack between the first and second tooth thereof for holding the main rack, while the auxiliary pawl 99 is out of engagement from the auxiliary rack, as shown in Figs. 5 and 8. As the lifting wheel 100 now turns it first moves the main rack backwardly one step during which the chimes are sounded for the first quarter hour, and the auxiliary rack is moved idly. Following this the detent arm drops sufficiently to move its main pawl 98 into engagement with the front end of the main rack and also engages its auxiliary pawl 99 with the space between the fourth and fifth tooth of the auxiliary rack. The rotation of the lifting wheel now moves the auxiliary rack back four teeth during which the first, second and third tooth cause the chimes to be sounded for the second, third and fourth quarters of the hour, and then the auxiliary rack is moved backwardly its fourth and last tooth or space during which the striking mechanism is operated to sound "one" o'clock.

During the first, second, third and fourth quarters of the hour the chiming disks 102,

103, 104 and 105 and the striking disk 106 are held in their rearmost position by the locking pin 122 engaging with the imperforate portion of the foremost disk 102, during which time the chiming disks operate their respective hammers but the striking disk 106 is moved away from the pin 149 of the intermediate lever associated with the hammer of the hour striking mechanism, as shown in Figs. 3 and 14 so that the latter is not operated. After the chiming disks have turned far enough at the end of the hour to sound the chimes four times, the locking opening 123 of the foremost chiming disk 102 registers with the locking pin 122 and is instantly engaged therewith by the pressure of the spring 121 which pushes all of the chiming and striking disks or wheels forwardly, thereby holding the chiming disks against turning but bringing the striking disk into line with the upper pin 149 of the intermediate lever 146 of the striking mechanism and causing the latter to be operated by the rotation of this striking disk 106.

At the completion of each additional hour the main counting rack advances one step further and therefore has to be moved backwardly a correspondingly increased number of steps in order to return the same to its home position by means of the lifting wheel, but the auxiliary rack at the end of each hour always advances four steps. As the main rack increases the number of its forward steps the first four return steps are always taken off the main counting rack to operate the four quarters of the chiming mechanism and the remaining return steps for operating the striking mechanism are partly taken off from the main counting rack and then always completed by counting the last four steps off the auxiliary counting rack. For example, when the time is "nine" o'clock, as shown in Fig. 4, the auxiliary rack moves forwardly four steps and the main rack moves forwardly nine steps at the end of this hour and in operating the chiming and striking mechanism the first four counts are taken off the main rack for sounding the four quarters of the hour, then the striking mechanism is operated nine times by taking the remaining five counts from the main rack and adding thereto the four counts of the auxiliary rack.

This organization of chimes clock is materially simplified in construction as compared with the structure shown in the application above mentioned, the same can be manufactured more economically, and it is not liable to get out of order.

The net result of all of these improvements combined is to prevent, as far as possible, jamming of the striking mechanism and the bending of parts and lockwork by the pushing of the minute hand against resistance in attempting to reset or restart the clock, and with these improvements it is possible to turn the minute hand at random backwards or forwards at any time, even during the process of striking of the clock, without meeting with resistance or jamming, and demonstrations have shown that it is practically impossible to disarrange the striking mechanism through manipulation of the minute hand with these improvements.

I claim as my invention:

1. A clock comprising a chiming and striking mechanism having a support, a rotary chime player drum provided with a stop opening, a stop pin adapted to be engaged with and disengaged from said stop opening by longitudinal movement of said drum relative to said pin; and an arm adjustably mounted on said support and carrying said pin.

2. A clock comprising a chiming and striking mechanism having a support, a rotary chime player drum provided with a stop opening, a stop pin adapted to be engaged with and disengaged from said stop opening by longitudinal movement of said drum relative to said pin; and an arm carrying said pin and pivoted on said support so as to be capable of swinging toward and from the axis of said drum.

3. A clock comprising chiming and striking mechanism having a stationary part, a driving shaft, a rotary player drum mounted on said shaft and movable lengthwise thereon, means for coupling said drum with said shaft upon moving the drum lengthwise in one direction on said shaft, holding means whereby said drum is held against turning upon moving the same lengthwise in the opposite direction on said shaft, a rock shaft provided with a shifting arm engaging with said drum and a cam arm, a rotary cam having a high face adapted to engage said cam arm and also having a low face, and a stop mounted on said stationary part and adapted to hold said cam arm out of engagement with the low part of said cam.

4. A clock comprising a chiming and striking mechanism including a driving shaft, and a player drum having a bushing mounted on said shaft, collars mounted on said bushing and player wheels mounted on said collars.

5. A clock comprising a chiming and striking mechanism including a driving shaft, and a player drum having a bushing mounted on said shaft, a central collar mounted on said bushing and provided at opposite ends with reduced necks, end collars mounted on said bushing at opposite ends of said central collar and having reduced necks at their outer ends, and player wheels mounted on said necks and having player teeth or tappets.

6. A clock comprising a chiming and striking mechanism including a driving shaft, and a player drum having a bushing

mounted on said shaft, a central collar mounted on said bushing and provided at opposite ends with reduced necks, end collars mounted on said bushing at opposite ends of said central collar and having reduced necks at their outer ends, and player wheels mounted on said necks and having player teeth or tappets the necks of said collars being riveted over said wheels, and the ends of said bushing being riveted over the endmost collars.

7. A clock comprising a chiming and striking mechanism having a rotary player wheel provided with an annular row of tappets, an intermediate lever provided on its upper arm with a laterally projecting pin adapted to be engaged by said tappets and provided on its lower arm with a laterally projecting shifting pin, and a bell lever having an upper arm adapted to be engaged by the lower pin of said intermediate lever and provided on its lower arm with a bell hammer said intermediate lever being provided with a hub and the upper arm of said bell lever being provided with a brake shoe adapted to engage said hub.

8. A clock comprising a chiming and striking mechanism including a hammer lever consisting of a hub provided with a circumferential groove on its periphery, and a rod having a loop secured in said groove, and arms extending from the ends of said loop.

9. A clock comprising a chiming and striking mechanism including a hammer lever consisting of a hub provided with a circumferential groove on its periphery, and a rod provided with a loop arranged in a part of said groove and secured therein by turning the adjacent edge portions of said hub over said loop, and arms projecting from opposite ends of said loop.

10. A clock comprising a driving shaft; a chimes drum slidable lengthwise relative to said shaft and having one of its player wheels provided with an annular row of coupling holes; a striking wheel also movable lengthwise of said shaft; a driving arm connected with said shaft and provided with a pin engaging with said striking wheel; and a coupling pin yieldingly connected with said arm and adapted to engage one or another of said holes in said player wheel.

11. A clock comprising a driving shaft; a chimes drum slidable lengthwise relative to said shaft and having one of its player wheels provided with an annular row of coupling holes; a striking wheel also movable lengthwise of said shaft and provided with an opening; a driving arm connected with said shaft; a tubular pin mounted on said arm and slidingly engaging the opening in said striking disk; a coupling pin slidable in said tubular pin and adapted to engage one or another of the holes in said player wheel; a spring mounted on said arm and pressing forwardly against said coupling pin; and a stop on the coupling pin adapted to engage said tubular pin for limiting the movement of the coupling pin under the action of said spring.

In testimony whereof I hereby affix my signature.

SAMUEL MAZUR.

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CHIME CLOCK

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Fig. 1.

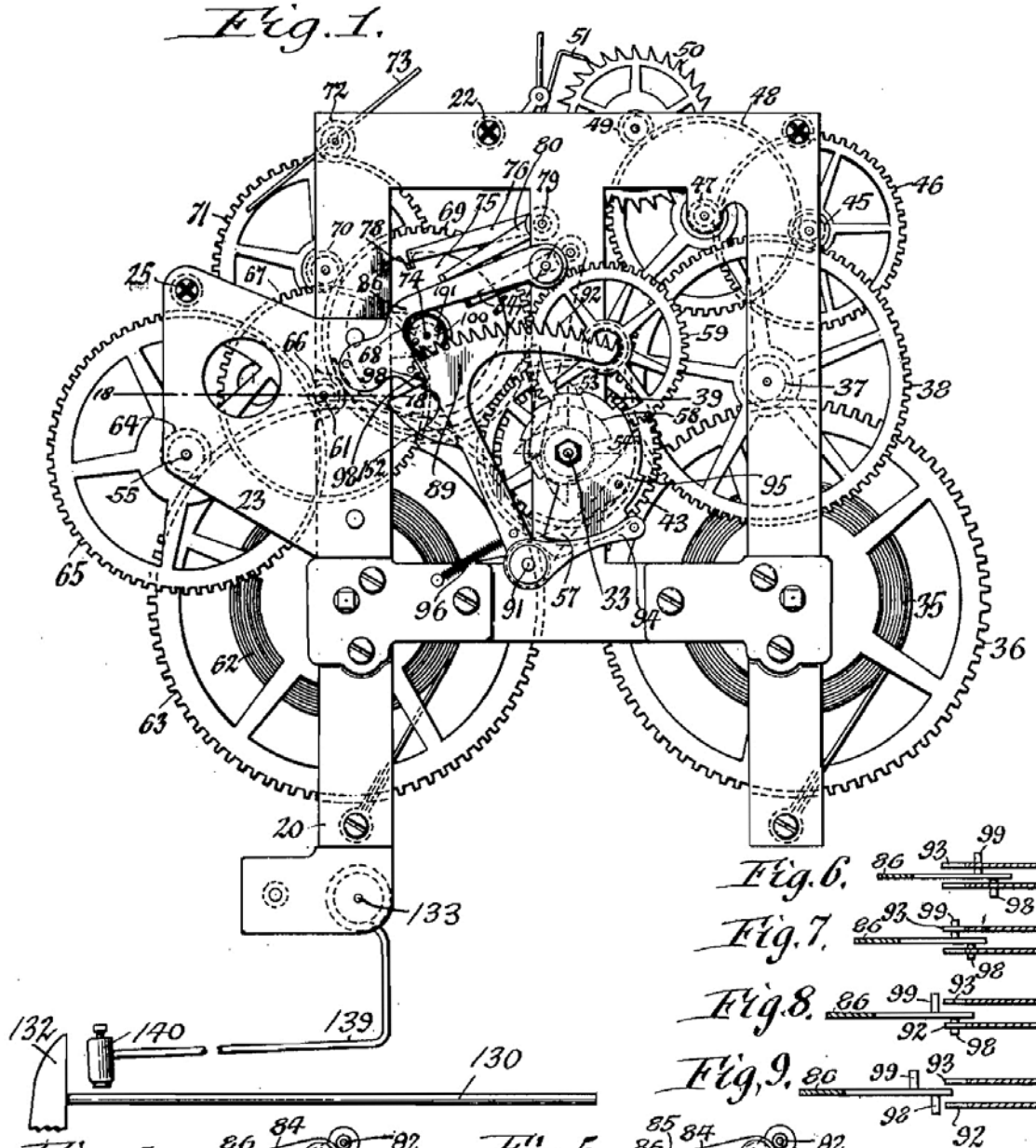


Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 4.

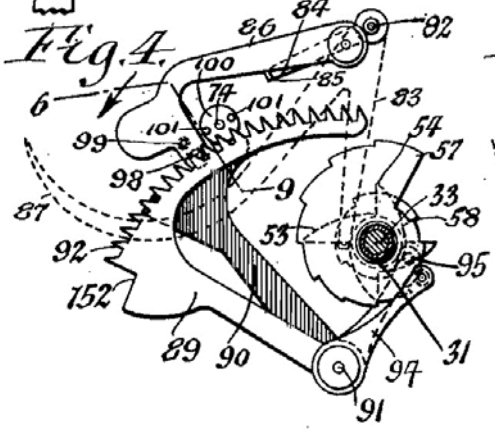
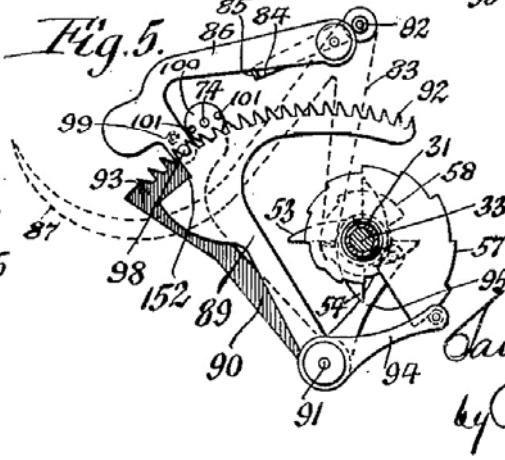


Fig. 5.



Inventor

Samuel Mazur

by Popp & Powers

Attorneys

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Fig. 2.

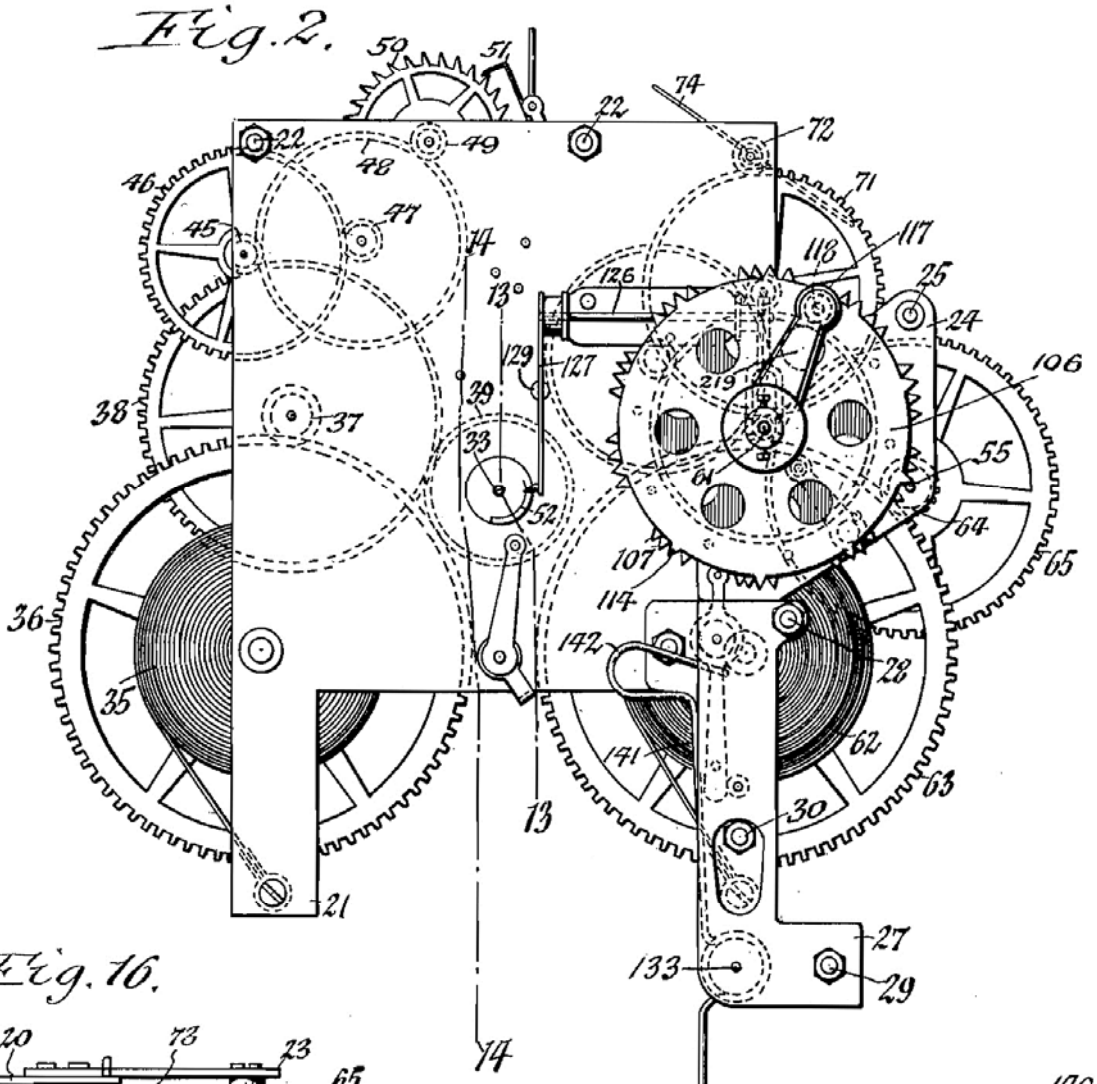


Fig. 16.

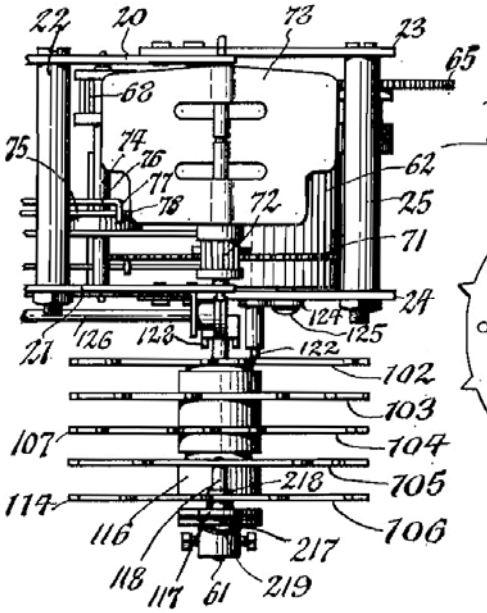
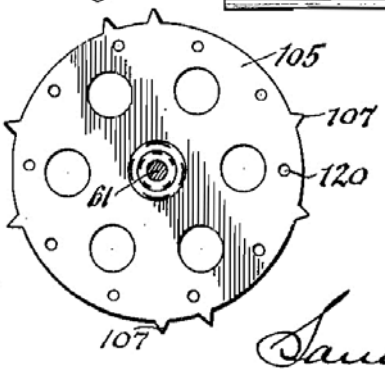


Fig. 10.



Inventor

Samuel Mazur

By Popp & Powers

Attorneys

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Fig. 3.

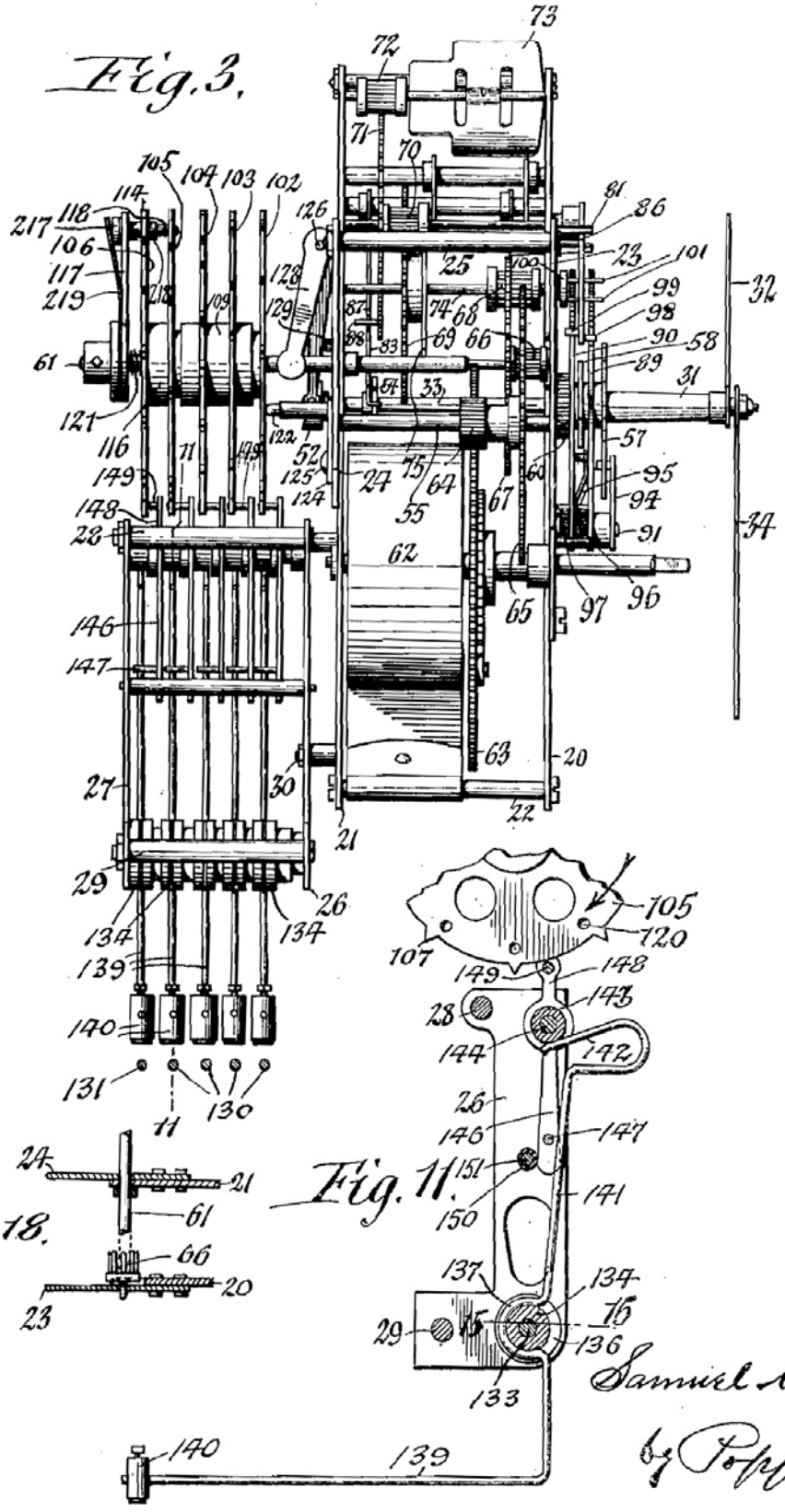

Fig. 18.

Fig. 11.

Inventor

Samuel Mazur

by Popple & Powers

Attorneys

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Fig. 12.

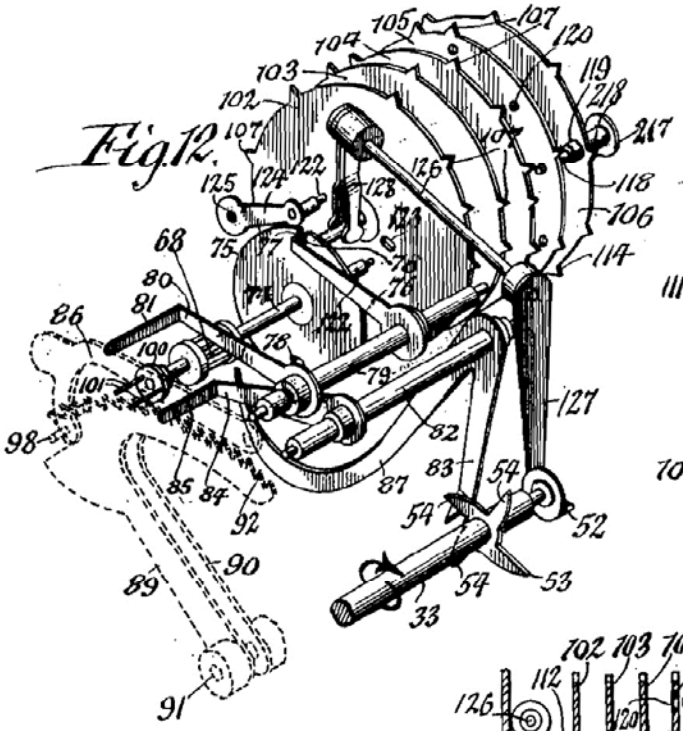


Fig. 17.

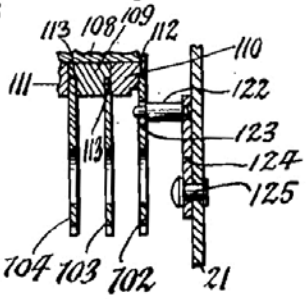


Fig. 13.

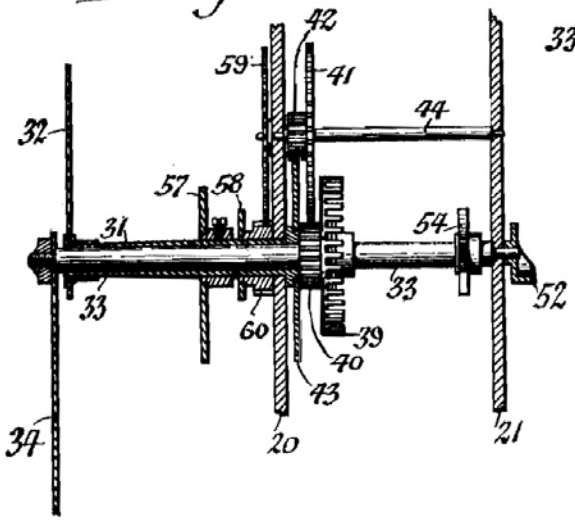


Fig. 15.

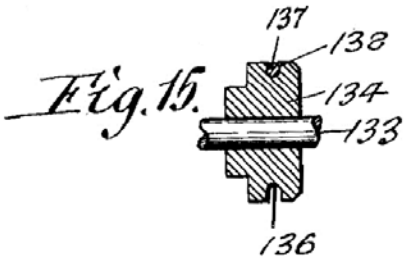
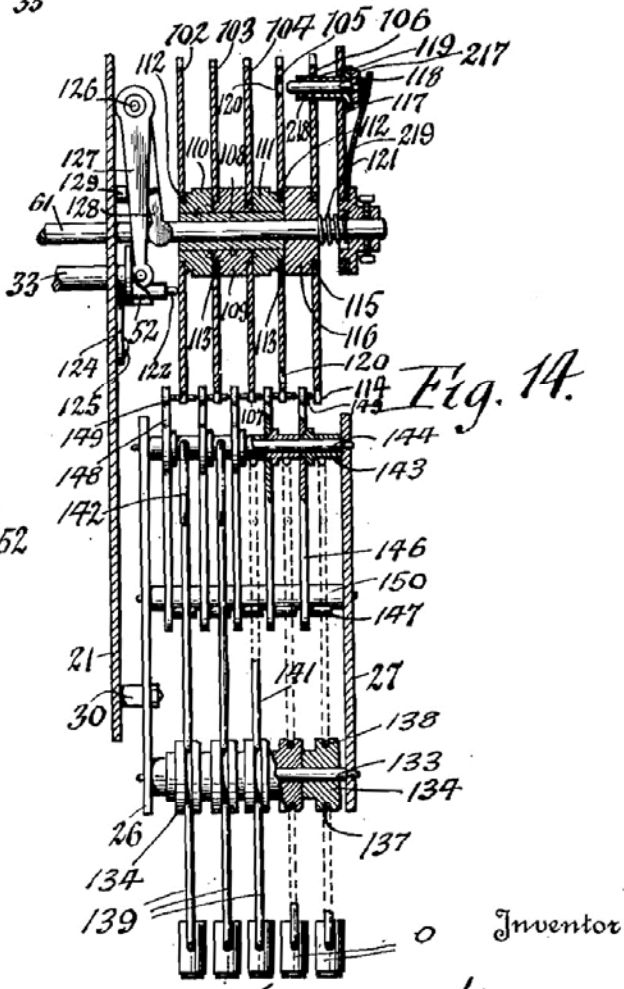


Fig. 14.



Inventor

Samuel Mazur

By Popp & Powers

Attorneys

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