## ***Compur Shutters***

Compur and Compur Rapid shutters represent the most advanced commercially available interlens shutters and, apart from a recent development marketed in the United States, have for a number of years formed the mainstay of many of the better-class miniature cameras which for one reason or another utilize an interlens shutter.

One of the advantages which this type of shutter offered to the camera manufacturer was its ready availability in a complete unit form. In many cases the manufacturers would buy suitable shutters for the lenses they proposed to use and fit them to an otherwise simple form of focusing mount. In this way they did not have to design a focal plane shutter which, with the interlock mechanism, forces a completely new approach from the designer.

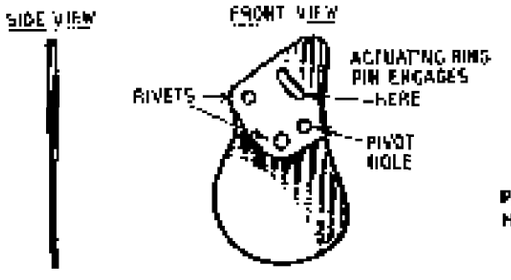
Another strong argument for the adoption of the interlens shutter was its very moderate price. The manufacture of Compur and Compur Rapid shutters was a monopoly of the Deckel factory in Germany. The output was sufficiently high to warrant and pay for highly specialized machinery and since the manufacturer was assured of a steady and expanding market he could well afford to keep the price down, thus making it exceedingly unprofitable for anyone to venture into competition. Germany's virtual stranglehold on shutter production was helped by the possession of all relevant patents. The necessity of circumventing these was primarily responsible for the Kodak Supermatic design which made the United States in some small way independent of German production. Now, after the customary 15 years, the patents have become void and at the time of writing, some firms are tooling up for the manufacture of Compur-type shutters.

In the Compur and Compur Rapid shutters, one movement is necessary to put the various springs in tension and another, a

separate one, to release the mechanism whereby the actual opening action takes place. Apart from this dual action there are three distinct operations which are performed by a single shutter. First is the opening and closing of blades. Second is the action which controls the length of time the blades are in the open position, Opening and closing take the same time but are separated by varying delay intervals to achieve the required exposure. Third is the ingenious mechanism to provide time and bulb shutter settings. The opening and delaying mechanisms are then set aside and a new system of lovers performs the action.

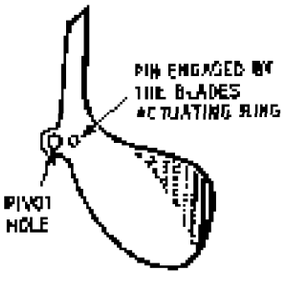
Apart from the timing mechanism, shutters of this type carry the diaphragm mounting and set the lens glasses at the correct separation. It required very considerable ingenuity by the designer to house all these elements in the narrow annulus,

The blades of both the Compur and the Compur Rapid shutter are made of very thin steel foil between 0.002 and 0.003 in thick, and



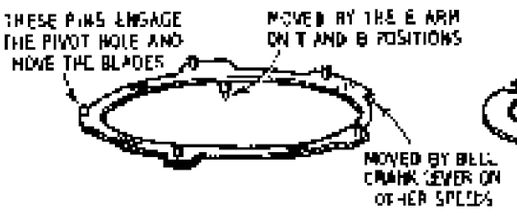

One of 5 shutter blades of the Compur Rapid

Fig. 4.15



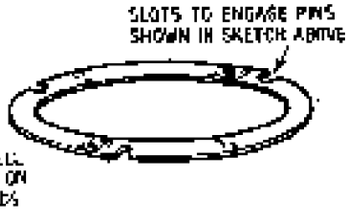

One of 3 shutter blades of the Compur shutter

Fig. 4.16




Compur Rapid blades actuating ring

Fig. 4.17




Compur blades actuating ring

Fig. 4.18

are pivoted as near to the centre of mass as possible (particularly in the case of the Compur Rapid). The blades are moved by a ring engaging pins or by the pins on the blade engaging recesses in the ring. Both of these are close to the centre of rotation so that a very small circular movement of the ring suffices to open the blades to the full lens aperture. The angle through which the ring has to be rotated is usually less than five degrees. The blades and the ring which moves them are shown in Figs. 4.15 to 4.18. The ring which moves the blades will be referred to as the actuating ring. All

actions of the shutter mechanisms are applied to it. The ring has usually two pins which can be pushed or pulled and force it to rotate.

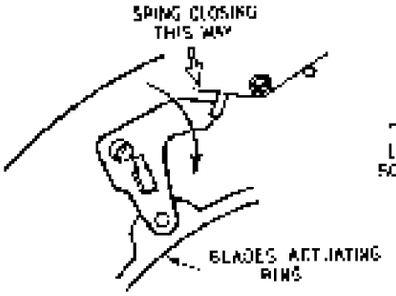
Normally the actuating ring is in. a position where the blades are closed. This is assured by the square lever engaging out of the pins and keeping the blades closed by the action of its spring (Fig. 4.19). It will be seen, from Fig. 4-19 that to open the blades one has to lift the arm of the square lever.

We shall now describe the mechanism responsible for opening and closing action performed on the square lever. The piece of mechanism performing the action is the operating pawl which because of its shape is commonly known as the bird pawl (Fig. 4,20), This is mounted on the setting ring and lifts the square lever by its " beat " which is shaped to provide the smooth opening action. To do so the operating pawl must approach the square- lever from the right (Fig. 4.21). The approach and withdrawal of the operating pawl are arranged by pivoting it in the middle so iliac it can dip its " beak" and raise its "tail" or vice versa according to the function it has to perform.

The movement towards and away from the square lever is forced on it by the setting ring. This ring is tenstioned and made ready for action when the Compur shutter is set. The setting action moves the setting ring clockwise, taking the Operating pawl away from the square lever. It must not on any account open the blades then, so the tail of the operating pawl is raised by the upper section of the D-shaped recess (Fig. 4.22). Thus the beak of the operating pawl dips and passes the bell crank lever without opening the blades as the tail of it enter from the upper portion of the D groove. The same action tensions the spring of the setting ring and towards the end of it the Setting ring is caught by the release catch (Fig. 4.23).

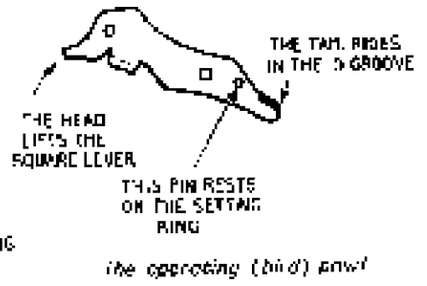
The shutter is now " set " and pressure on the release lever will be necessary to let the setting ring slip back and the operating pawl approach against the bell crank lever. The natural position of the operating pawl is with its beak up ; a small spring tensions it this way. So when the clockwise movement finishes, its tail travels along the curved portion of the D groove and finally rests on the bottom of it. When the setting ring is released the tail of the operating pawl is held firmly by the straight portion of the D groove. It thus rides to the left, its beak stoutly raised, and on coming to the square lever raises it, thus opening the blades. The blades gradually open as the square lever rides over the head of the operating pawl and then close as it comes, down on the other side.

Fig. 4.24 shows the do delay mechanism. The starting point here is the quadrant gear which has to be pushed away for the ring to slip past it. The amount by which the quadrant gear gets into the way of



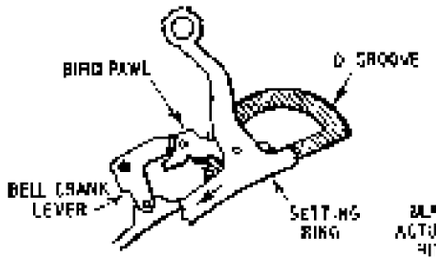

The square lever

Fig. 4.19



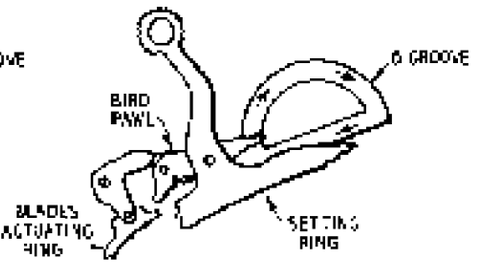

the operating (bird) pawl

Fig. 4.20



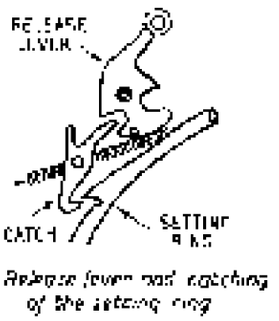

Beginning of the opening action

Fig. 4.21



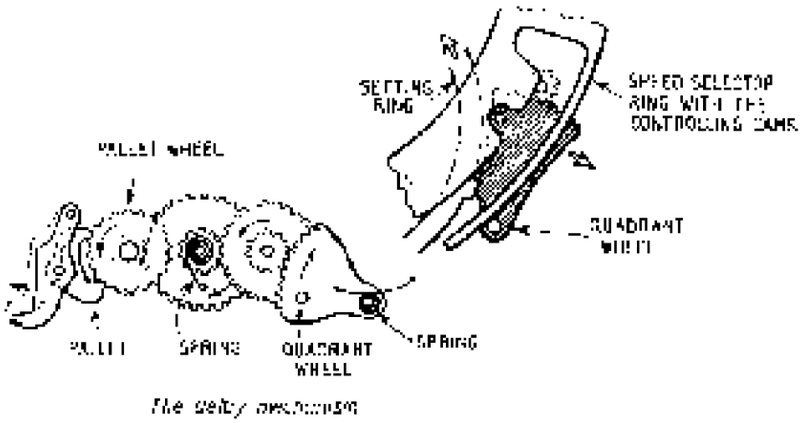

Beginning of the tensioning action

Fig. 4.22




Release lever and catching of the setting ring

Fig. 4.23




The delay mechanism

Fig. 4.24

the setting ring is determined by the cam ring which is moved on selecting the particular shutter speed. The quadrant gear is always tensioned against the cam ring so it will come out completely if the cam ring permits. It is connected to the gear train which finally terminates in a pallet wheel. At this moment the tail of the operating pawl finishes riding the straight section of the D groove and the pawl nicks up its head, releasing the square lever completely ; the blades then close fully,

To the control of Compur shutter speeds there is first the full, undisturbed operation by the delay mechanism where the tension of single or double. springs on the selling ring causes the fast traverse of the ring and performs the opening and closing action described.

Secondly, the movement of the selling ring is impeded by the train of gears and a pallet. A pallet is in some respects similar in action to the escapement of a watch but is more robustly constructed to withstand the sudden forces released into it by the operating spring.

We have seen how the closing action of the blades takes place gradually and is accurately determined by the shape of the head of the operating pawl and also by the moment when the tail of the operating pawl can flick up the D-shaped recess. The delaying action takes place before closing begins and the effect is plotted in Fig. 4.25. We shall now have to divide operations according to whether Compur or Compur Rapid shutters are being considered. This is best done by the following table :

| *Time* | *Type of Shutter* | *Setting Ring* | *Train of Gears* | *Pallet* |
|---|---|---|---|---|
| 1/500 | Compur Rapid | receives additional push from extra tension spring | does not engage | does not engage |
| 1/250 | Compur Rapid | ordinary spring only | does not engage | does not engage |
| 1/300 | Compur | additional spring in operation | does not engage | does not engage |
| 1/100 | Compur and Compur Rapid | ordinary spring | very slight engagement of the quadrant | does not engage |
| 1/50 | Compur and Compur Rapid | ordinary spring | light engagement of the quadrant | does not engage |
| 1/25 | Compur and Compur Rapid | ordinary spring | full engagement of the quadrant | does not engage |
| 1/10 | Compur and Compur Rapid | ordinary spring | light engagement of the quadrant | pallet engages pallet wheel |
| 1/5 | Compur and Compur Rapid | ordinary spring | moderate engagement of the quadrant | pallet engages pallet wheel |
| 1/2 | Compur and Compur Rapid | ordinary spring | fairly heavy engagement of the quadrant | pallet engages pallet wheel |
| 1 | Compur and Compur Rapid | ordinary spring | full engagement of the quadrant | pallet engages pallet wheel |

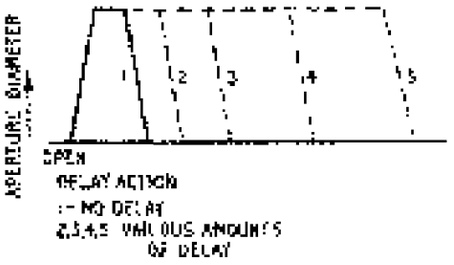



Fig. 4.25

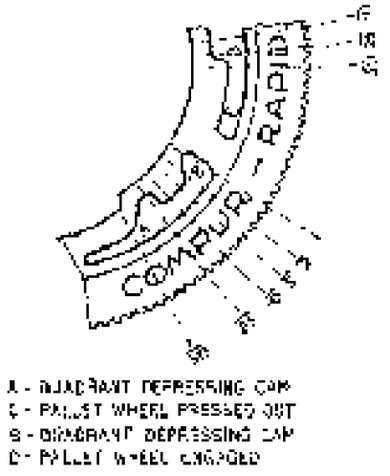



Fig. 4.26

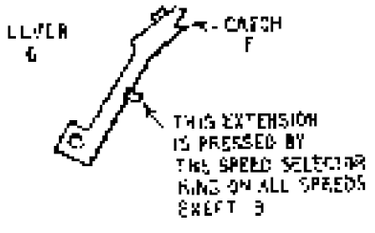



Fig. 4.27

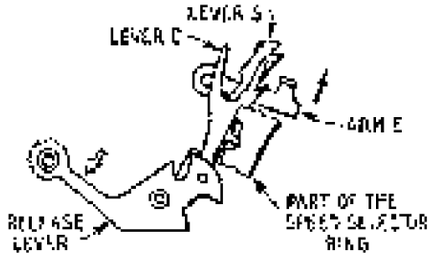



Fig. 4.28

The shape of the cam on the cam ring is very important and has been determined by the manufacturers after much research. It is therefore fatal to the shutter to have this cam filed away, as happens when eager amateurs decide to " improve " on the original design. The approximate shape of the cam ring is shown in Fig, 4.26.

The bulb setting action of Compur shatters was designed for use with cameras having automatic film winding devices and shutter setting mechanisms. Unlike the modern types of Compur shutters. it was necessary to cock the shutter setting ring for the B movement.

Referring to Fig. 4.27, catch pawl G is brought into play by (he notch on the speed selection ring freeing the movement of this pawl when the shutter is set on. B, and the shutter release levers allowing it to interrupt the action of the setting ring.

Assuming the shutter is set, upon depressing the release the pawl moves toward the setting ring and the catch F engages in a projection in the suiting ring., arresting its action just as the shutter blades have reached the fully open position.

When pressure is removed from the release lever, the spring tension returns pawl G and permits the setting ring to travel on its way and thus close the shutter blade. Normally this lever is pushed out of reach of the setting ring by the speed selection ring. On B settings however, the speed selection ring allows this lever to come into the recess cut in the ring (Fig. 4.28).

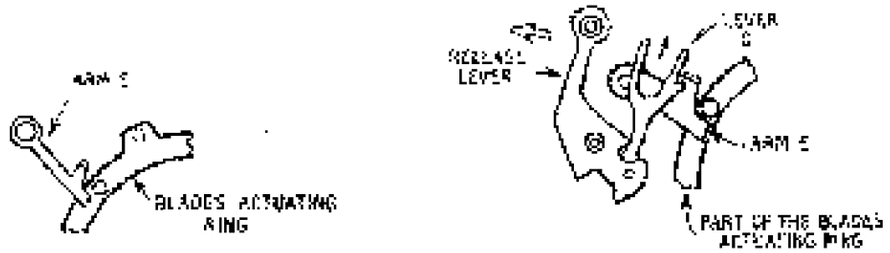



Fig. 4.29

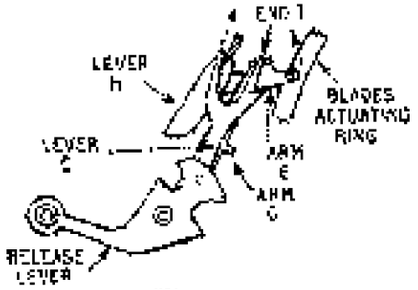



Fig. 4.30

The blades actuating ring has to be moved by another arrangement consisting of the lever E (Fig. 4. 29} pushing one of the pins on it. This lever can be pushed against the blades actuating ring by another lever which we shall term C, Lever C is normally held away from E by the speed selection ring pressing on the lever G, but on the bulb position the recess in the ring allows it to come nearer to the arm E. It is directly connected with the shutter release lever (Fig, 4.30). When this is pressed lever H pushes arm B which moves against the blades actuating ring and opens them. On letting the release free the arm E comes hack, and lets the blades close.

***Compur Rapid Fully Synchronized Shutter***

In the latest development of the Compur shutter the Compur Rapid seems to be the only design coming out in quantity production. This shutter has both the X and the M synchronized arrangements (see page 125). It differs from the model described above by having an additional escapement mechanism operated by a separate quadrant wheel. This mechanism terminates with a final gear having a cam which actuates a lever. The lever in turn closes one electrical contact. Thus the necessary accuracy of the small delay in the M-setting is produced by the mechanical magnification of the movement of the release lever accompanied by the controlled timing by the pallet and the pallet wheel. The X delay is performed by the linking of the blades actuating ring movement via the angle lever 10 the contact spring. Thus the contact is closed when the blades arc in the fully open, position. The time setting is eliminated and a new bulb setting mechanism is used,

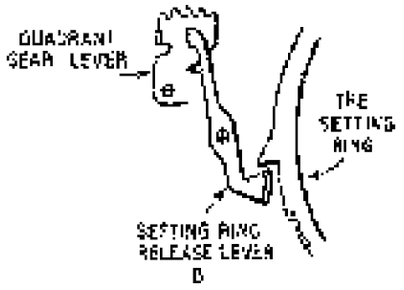



Fig. 4.31

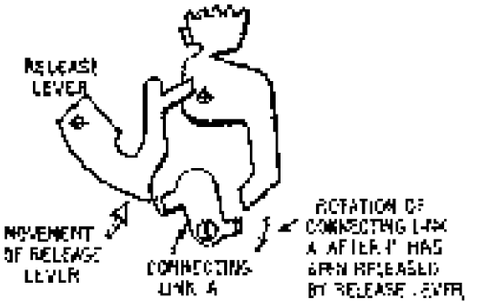



Fig. 4.32

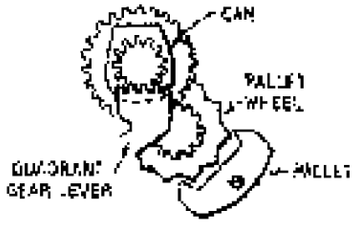



Fig. 4.33

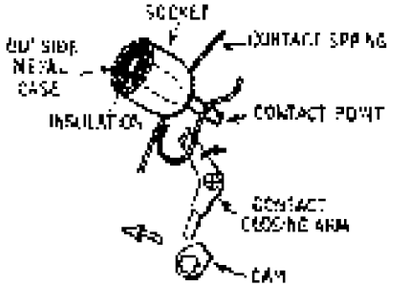



Fig. 4.34

All modern shutters lend to dispense with the separate time and bulb settings and provide a bulb setting only, The time setting can still be obtained by the body release lock which is a part of the camera rather than of the shutter. The advantage lies in clearing some space in the shutter annulus which can be occupied by the synchronizing delay system.

Furthermore, as most modern cameras employ a combined shutter winding and film transport mechanism, it is necessary to forgo any shutter action which does not rely on the normal mode of shutter operation—the rotation of the setting ring.

In the bulb setting of the Compur Rapid, a lever is arranged to arrest the movement of the setting ring in the position where the blades are fully open. This lever is brought into operation under setting B only when, the cam ring allows it to move. When the release lever is pressed, the notch on the arm of the release lever moves behind the hack of the B lever and supports it in keeping the setting ring stationary all the " open " position by the blades. The removal of pressure from the release lever allows the B lever to be pushed buck by the rotation of the setting ring, thus permitting the complete rotation of the actuating ring (Fig- 4.31),

When the release lever is pressed it rotates a connecting link A (Fig. 4.32), Against the arm of this lever rests the arm of the synchronizer quadrant gear lever. This quadrant gear lever is tensioned so that it will rotate clockwise (Fig. 4.33) and once the link A is rotated by the action of the release lever it can do so.

Three things happen as the result of the rotation of the quadrant gear lever. After the flash contacts are closed, the escapement mechanism is. brought into action, providing the delay, and at the appropriate moment the setting ring is released, bringing the blades into action. The escapement mechanism consists of a pallet wheel driven by the small gear, connected via gears to the- quadrant gear lever. On one of these gears a cam strikes the contact closing arm, the other arm of which bends the contact spring and makes it touch the " live " contact terminal (Fig. 4.34).

The third action (that of releasing the sotting ring) is performed by the synchronizer quadrant gear lever and the setting ring release lever. The projection on the quadrant lever arm strikes the end of the setting ring lever, the other arm of which releases the setting ring,

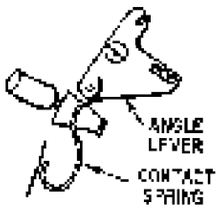


Fig. 4.35

The timing of these actions is such that approximately 17 millisec elapse between the closing of the contact points and the opening of the shutter blades, Thus the setting ring has to be released a few milliseconds earlier. The timing sequence runs as follows :

(1) Pressing of the release lever by the photographer.
(2) Closing of contact points.
(3) Releasing the setting lever thus actuating shutter mechanism proper.

The setting X of the shutter delay makes the contacts close at the moment when the shutter is fully open. The contact closing arm is moved by the angle lever which engages the curved end of it and pulls down, to dose the gap (Fig. 4-35).

***Prontor II and Klio shutters***

The Prontor II and Klio shutter represent the same level of mechanical achievement as the Compur, but the principle of their action is somewhat different, The following description is given to show how the same aim may be- achieved by a different mechanical design.

In the Cumpur shutter the bird pawl performed the action of opening and closing the blades. In the present case the action can best be compared with a toggle switch, slipping when pulled one way and engaging when released.

Fig. 4.36 shows the setting lever which is connected to the hooking arm. As in the Compur shutter, a small movement of the blades actuating ring is sufficient, to open the shutter. If left alone, the blades actuating ring will close the blades under the action of its own spring, The blades actuating ring is situated on one side of the shutter easing and can bo moved from the other side by its pin

which projects through a small hole In the casing. The selling lever itself is spring-loaded, in the direction shown in Fig. 4.37 so that force is needed to tension it. When the shutter is tensioned, i.e., toe selling ring end is pulled by the photographer; the lever .starts to route and the hooking arm moves as shown. It slips underneath the blades actuating ring pin because the cut-out in the hooking arm Is slightly chamfered (Fig, 4.37),

As the tensioning movement continues, the attachment point of

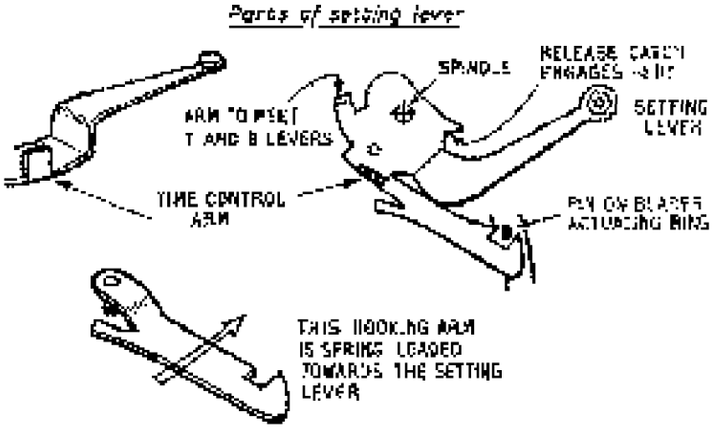



Fig. 4.36

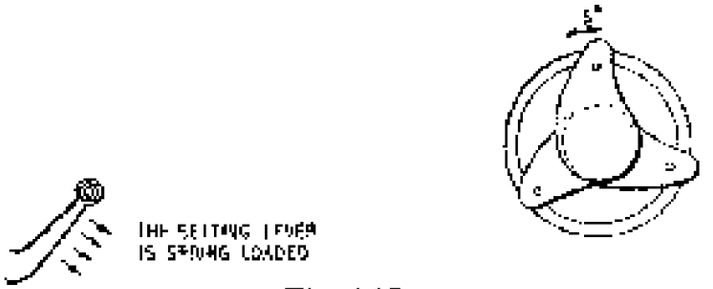



Fig. 4.37

the hooking lever travels on the periphery so that the cut-out portion of the hooking lever slips back to embrace the blades actuating ring pin. This time, however, the pin is located deeper in the cut-out and there is no possibility of the inclined portion allowing it to slip. When the tensioning movement is completed, the release catch C (Fig. 4.38) engages the protruberance on the setting lever. The catch C is connected via. the link lever C ; the release lever. When this is pressed, it pulls the link lever and rotates the catch lever G ; this in turn releases the setting lever which is now free to rotate under the action of its powerful spring. The hooking arm pushes the pin on the actuating arm of the blades and then as the setting lever continues to revolve, the hooking arm pulls the pin backward and thus closes the blades.

The setting lever has another flat on it which on rotating engages

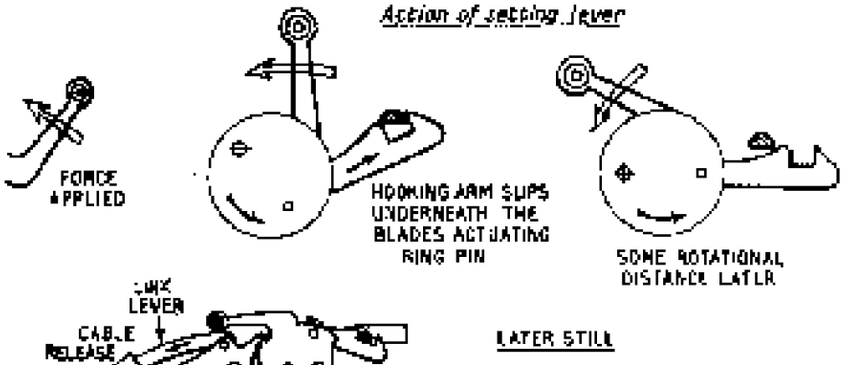



Fig. 4.38

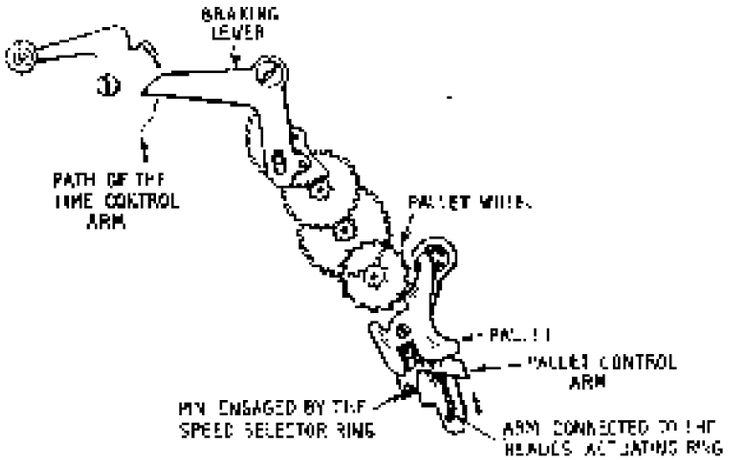



Fig. 4.39

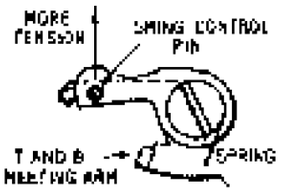



Fig. 4.40

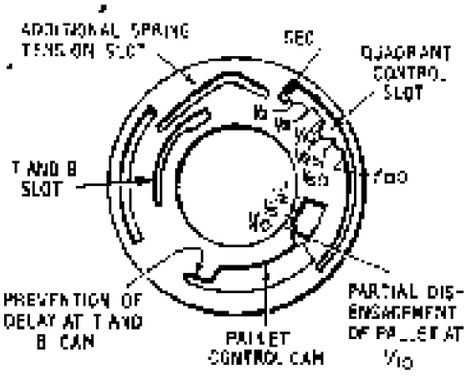



Fig. 4.41

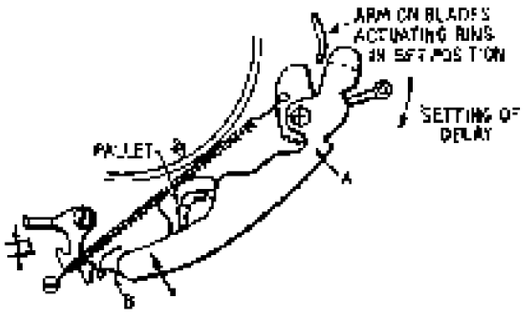



Fig. 4.42

the braking lever (Fig. 4.39), The retarding lever a part of the pallet arrangement. When the setting lever spring alone decides on the shutter speed, additional spring is brought into play to increase its tension (Fig. 4.40).

There are, therefore, several possible timing arrangements. On 1/300 sec no delating device is introduced. At 1/100 sec the spring makes the setting lever revolve and the braking lever is engaged for a moment, making the gears in the gear train revolve, but the pallet wheel is out of action. At 1/50 sec and 1/25 sec the engagement of the quadrant increases and at 1/10 sec the pallet is engaged in the pallet, wheel, Then, with the pallet engaged, the times of 1/5, 1/2 and 1 sec are achieved, by gradually increasing the insertion of the quadrant wheel and thus the braking arm delays the setting lever for a correspondingly longer time. All the actions listed above are controlled by the speed control ring (Fig. 4.41).

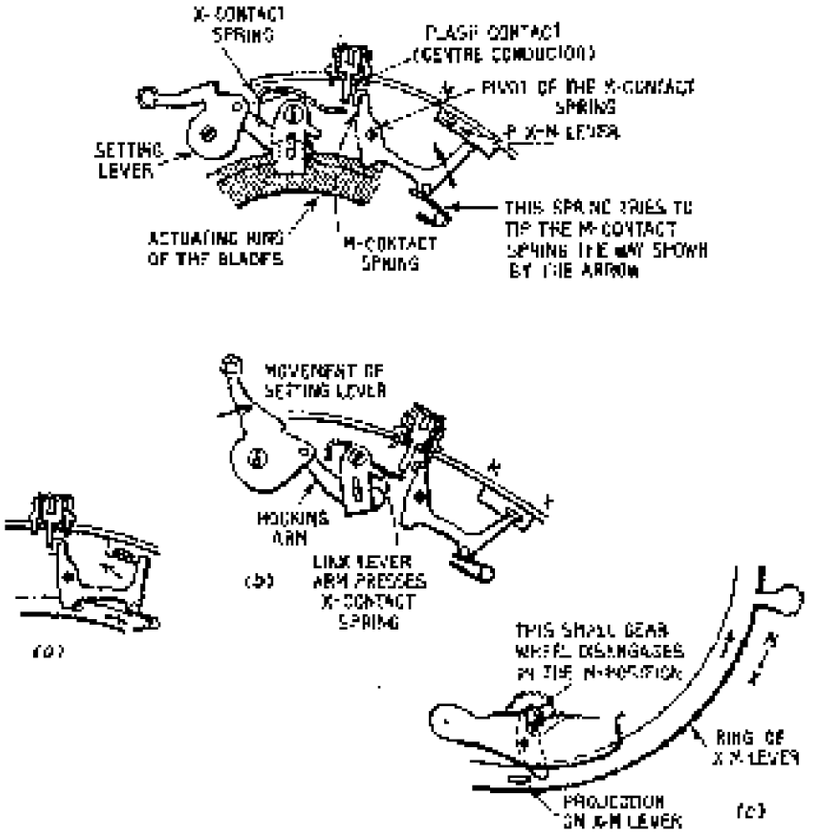
On the bulb setting the B arm is allowed to impede the setting lever arm, Arm B is tensioned anti-clockwise by the spring. As the release lever is pressed, the pin on the catching arm is lowered and arm B can arrest the setting fever on its way back after it has already opened the blades. On releasing the pressure on the- release lever, arm B is withdrawn and the setting lever can complete its travel,

To allow for the fixed delay time before the shutter can be operated (for self portraiture), the actuating ring of the blades has, besides the pin by which it is operated, an additional arm which may be prevented from moving by the delay mechanism. The prevention is performed by a quadrant gear with a cut-out sector into which the inn on the blades actuating ring can enter, once the quadrant gear has suitably revolved, The time of revolution of the quadrant gear constitutes the delay time. The setting of the delay tensioning is effected by a lever directly connected to the quadrant wheel and held by an auxiliary release lever (Fig. 4.42), Upon pressing the shutter release, the shutter setting arm is freed and moves through a small angle, sufficient to operate the release which trips the delay mechanism. This latter mechanism arrests the movement by the actuating ring of the blades when it has completed, its travel.

The problem of synchronization will be more fully dealt with inter in Chapter 6. The present trend in camera construction is to dispense with external synchronizers and make the shutter of the camera provide the necessary synchronizing mechanism. It required much ingenuity to crowd one more mechanism into the alreadv overcrowded space in the interlens shutter, but this has been now successfully accomplished. by all the leading manufacturers. There are two possible delay schemes. One is designed for expendable flash bulbs and the shutter is arranged to open some short time after

the electrical contact have closed and started the ignition of the primer in the bulbs. The delay in this case is of the order of 20 millisec. The other arrangement provides for the use of the electronic flash where the shutter must be fully open during the very short time of both the triggering and firing of the electronic flash. In this case there is no delay whatsoever and the contacts are closed at the full opening of the shutter

These two synchronizing problems have been successfully solved by the designer of the Prontor SV shutter, The commonly accepted




**Fig, 4.43—Prontor SV** fully synchronized shutter, (a) The movement of the blades actuating ring allows the M-contact spring to tip anti-clockwise and make the contact, *(b)* In the X position the X-M lever prevents the rotation of the M-Contact spring. (c) The projection on the X-M ring engages the arm of the pallet gear train and disengages it at thc M position,

continental marking denotes **X** as the instantaneous flash (no delay) setting and M as the 20 millisec delay setting,

***M setting***, When the release lever is pressed, its first section is to free the setting lever. The initial small rotation of the setting lever moves the s e t t i n g ring of the blades through a small angle insufficient to open the blades but large enough to trip the delay mechanism, in the same period the fash contacts are closed Fig, 4.43). To achieve a much smaller delay than that normally afforded

by the delay mechanism, its pallet wheel is disengaged by the lever operated by the synchronizing arm in. the M position (Fig. 4.43c). Thus the delay mechanism works only due to the inertia of the gear train this being designed to provide, together with the shutter inertia a delay of approximately 20 millisec, On completing its action, the delay mechanism rotates the quadrant wheel sufficiently to free the actuating ring of the blades and these are then opened and closed in the normal manner. The speed of opening and closing is controlled by the escapement mechanism (not to be confused with the delay mechanism) and governed by the position of the cam ring.

***X setting.*** Fig. 4.43 shows the double set of electrical contacts inside the shutter with the synchronizing arm set to the M position. We saw that the small movement of the actuating ring allowed the M contact to rotateanti-clockwiseand touch the centre conductor of Hie flash contact (Fig. 4.43a). When, however, the synchronizing arm is set to the X position (Fig. 4.43b) the synchronizing arm prevents the. tipping of the M contact. The synchronizing is performed by the X contact which is linked to the hooking arm (Fig. 4.43b) and so arranged as to touch the flash contact when the blades are fully open.