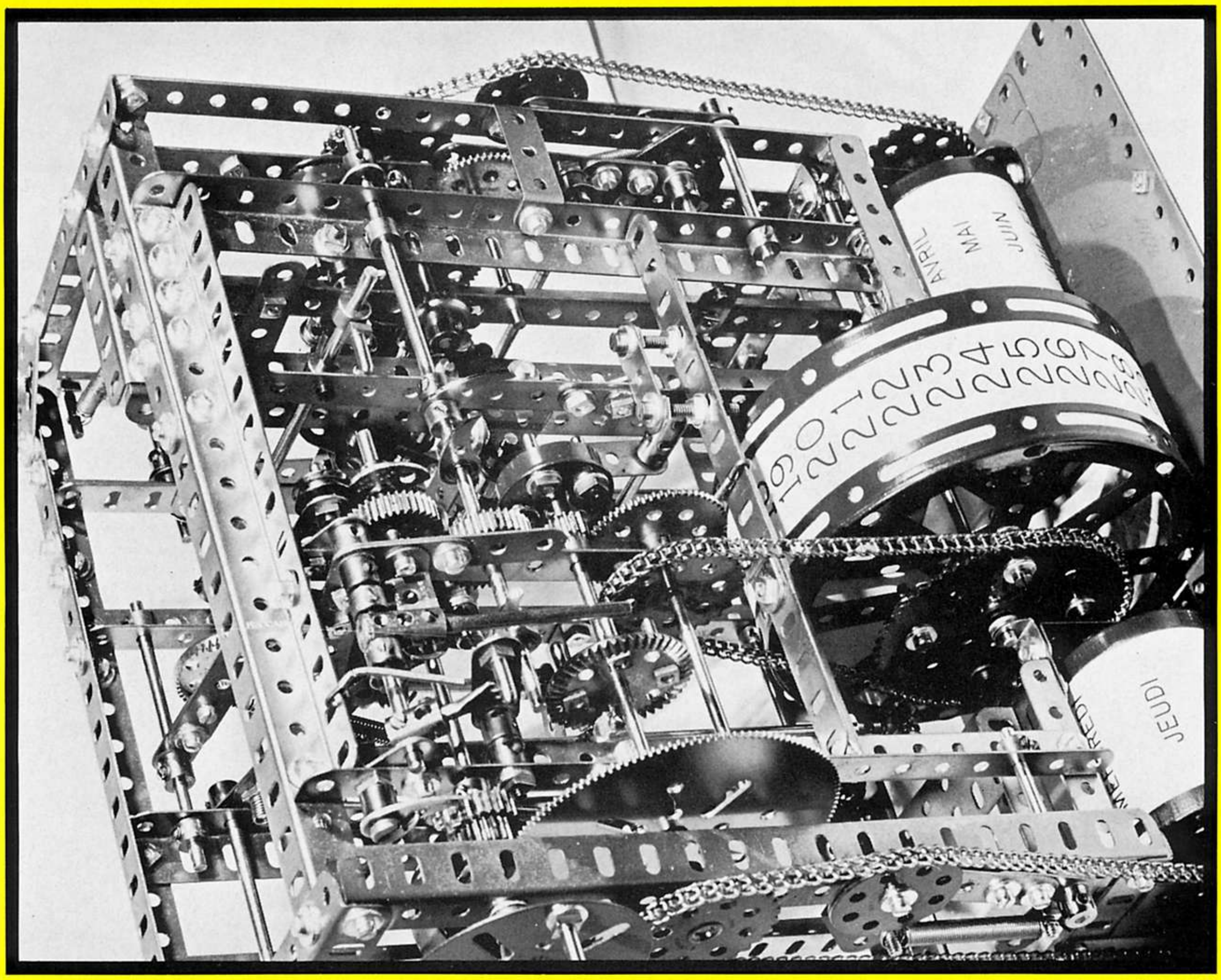

FROM FRANCE:

A PERPETUAL CALENDAR UNIT

A FASCINATING, COMPLEX MECHANISM FOR THE ADVANCED MECCANO CONSTRUCTOR

DESIGNED BY **GEORGES GOMBERT** — DESCRIBED AND PHOTOGRAPHED BY **BERT LOVE**

Not all Meccano constructors are clock enthusiasts, but those who enjoy exploiting the Meccano system or even examining its potential will be fascinated by the complex mechanism designed by Georges Gombert of Southern France.

I had the good fortune to be invited to the Congres Des Amis Du Meccano at Easter time in 1975, where I saw the Perpetual Calendar Unit illustrated here. Designed as a sub-section of a complete weight-driven astrononomical clock (see Meccano Engineer Nº 9, 1975 September p203), this unit was specially rebuilt by Georges in immaculate blue, gold and maroon French Meccano parts for the Easter meeting of the club.

Georges spoke almost no English and his French was too rapid for me to comprehend, so the pictures shown in this article must largely tell the story. As the ubiquitous camera gear had been carted along at the time, the four shots shown were taken at the club meeting in Paris.

A detailed description of the entire unit would take up more than a fair share of magazine space, so only a general description is attempted in this article. However, if we consider the display required of a perpetual calendar we can then look at the mechanism performing the required sequencing in some detail.

First of all, we require to show the seven days of the week — which is no real problem as this only requires a 7:1 reduction from a one day's (24 hours) input from the main clock motion. Next it is necessary to show the numbering of the days — which can be anything from 28 to 31 — and this is where the problems of a perpetual calendar mechanism begin to arise. As each month is accurately counted off with the correct number of days, the fresh month title must appear in due sequence. In each case the required title or day number is displayed on a rotating drum which presents the correct combination of day, date and month in the three slots formed by gaps in the front plating of the calendar unit.

Let us first consider the day of the week which appears on the left hand drum (viewed from the front panel of the unit). Fig.1 shows this clearly and indicates that the top of the drum is rotating towards the rear of the unit in order that JEUDI (Thursday) is displayed on the front panel before VENDREDI (Friday). This day drum is directly driven 1:1 by 1½" Sprocket Wheels from a short shaft carring a 133-tooth Gear Wheel. (See Fig. 1). In turn, the input shaft for the whole unit is directly coupled to the 133-tooth Gear by a 19-tooth Pinion giving us the 7:1 reduction required for the days of the week.

For demonstration purposes, a Face Plate with Threaded Pin is used on the input shaft, and one revolution will be equivalent to a 24 hour run. A 'pulse' type of input is required to move the day drum smartly to its new title at the end of the day. A spring-loaded differential can store this energy to give one full revolution to the input shaft when triggered at the end of a full day. Fig.1 shows a Pawl and Ratchet preventing reverse rotation of the input shaft, but a Meccano Cam half way across the rear of the unit has a spring-loaded 'keep' lever to ensure correct holding in registration of the day title at the 24 hour 'pulse'.

Transmission of all other motions to the calendar unit are via a sliding lay-shaft —clearly shown is Figs. 1 & 2 — running across the top of the framework parallel to the input shaft and carrying a 1" Gear Wheel, four Pawls with bosses, and two Collars. The purpose of these components will be discussed later in the text. Meanwhile we will look at the Date Drum and consider its timing-gear chain.

A pair of Hub Discs form this drum which is carried in simple ½" Angle Bracket journals as shown. The side shown in Fig.1 has a (3") 56-tooth Sprocket Wheel bolted to the Hub Disc by ¾" Bolts packed with Washers for stand-off clearance. The other side of the drum is carried on a Bush Wheel and careful study of Fig.2 will reveal an End

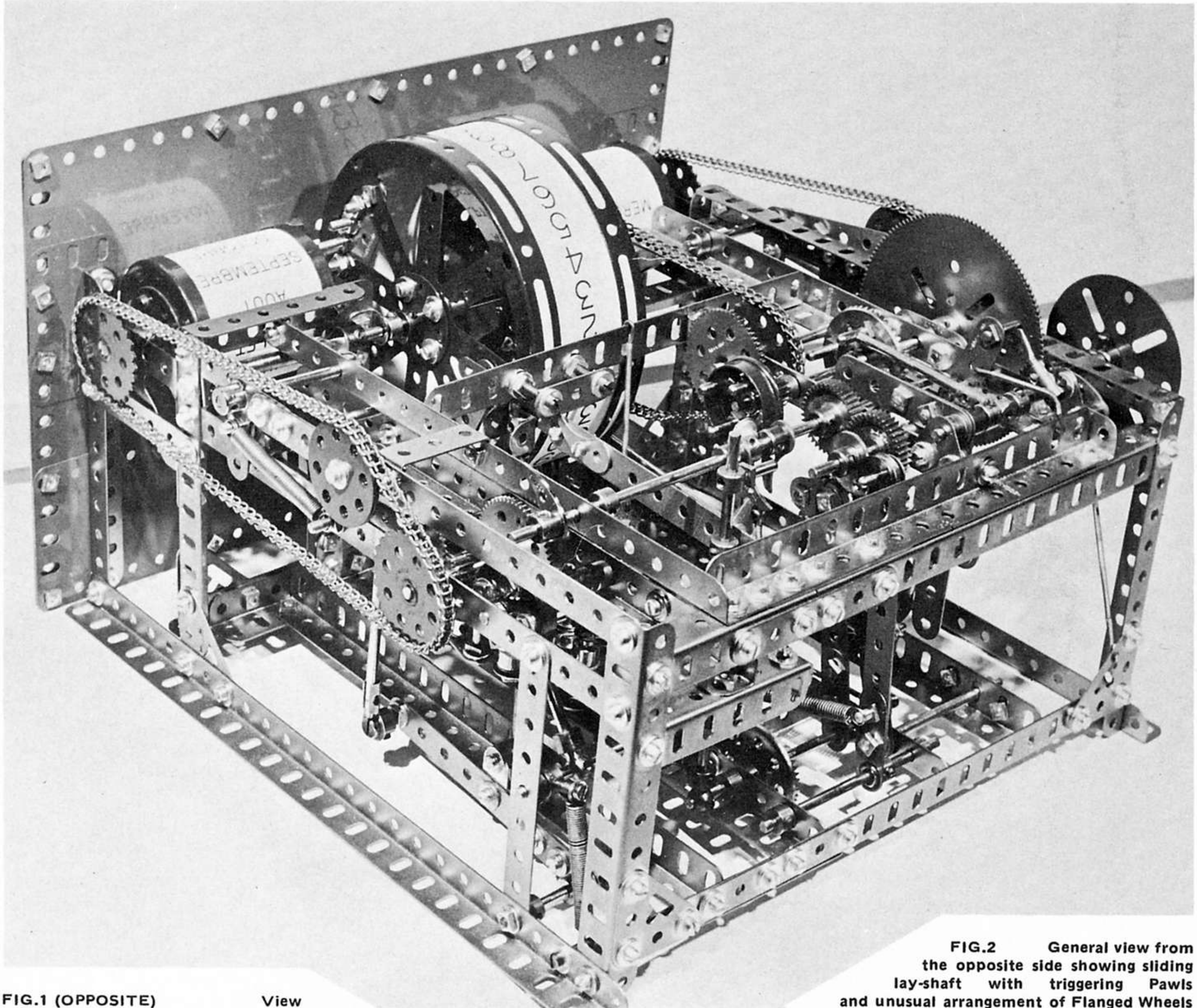

FIG.1 (OPPOSITE) View of the Perpetual Calendar Unit showing general input drive arrangements and the Sprocket Gears driving the various date drums

FIG.2 General view from the opposite side showing sliding lay-shaft with triggering Pawls and unusual arrangement of Flanged Wheels with Threaded Pins, acting as 'four-peg' pinions. The triggering boltshanks for the months can be seen protruding from the Hub Disc

Bearing adjacent to the Bush Wheel. Attached to the End Bearing is a standard Tension Spring secured to the side of the framework by an Angle Bracket (See also Fig.1). The purpose of this spring is to store a rotary tension as it is twisted by the advancing Date Drum to effect a rapid re-cycling of the drum to 'Day 1' when the end of the month arrives. This unorthodox use of the Tension Spring is just one of George's unique applications of standard parts in his calendar unit.

Now let us consider the gear ratios needed to get a full month's drive to the Date Drum. 31 is the highest number of days required, but 31:1 is an awkward ratio. Georges solves this problem by using the simpler 32:1 ratio, but employs only 31 steps as a maximum, arranging for the Date Drum to 'fly-back' to Day 1 when it has reached the maximum number of days required for any particular month.

If we go back to the 24 hour input shaft (Fig.1), we can see that this drives the parallel layshaft via a pair of 1" Gears maintaining a 1:1 ratio at this stage, but reversing the direction of the layshaft. The next shaft in line appears to run through the 133-tooth Gear mentioned earlier, but a 1½" Strip can be seen in Fig.2 adjacent to the boss of the large Gear where it acts as a stand-off journal for the short independent shaft of the 133-tooth Gear Wheel.

Fig.2 clearly shows that the first Axle Rod carrying the drive to the Date Drum is fitted with a large Flanged Wheel carrying four short Threaded Pins. This arrangement provides a simple but effective four tooth (or four peg) gear, very suitable for the rapid pulse input from the 24 hour shaft at the end of the day. Motion to the four pegs, one at a time, is imparted by one of the Pawls with boss on the layshaft. By virtue of the direction of rotation of the layshaft, the outer curve of the Pawl arm gives a smooth lifting and turning motion to the pins in the Flanged Wheel, moving it a quarter of a turn at the end of each 24 hours.

Just behind the Flanged Wheel (see Fig.1), a 15-tooth Pinion passes-on the quarter turn of the shaft to a 60-tooth Gear Wheel on an Axle Rod driving the Date Drum via Sprocket Chain from a (1½") 28-tooth Sprocket Wheel. We thus have a gear ratio of 4:1x4:1x2:1 = 32. Again we must have a positive register for the Date Drum which is checked in one direction by the twisting resitance of the Tension Spring already mentioned.

Attention should now be given to the large Bevel Gear fixed to the shaft carrying the Flanged Wheel with four pins. It is clear from the illustrations that this Bevel Gear also carries four Short Threaded Pins, and these provide the necessary register for the Date Drum — being locked at the quarter turn by a falling 2½" Axle Rod. This can be seen in both Fig.1 and Fig.2, mounted in a Coupling free to hinge on a 3" Axle Rod running parallel to, and just above, the input shaft. Only when the Date Drum re-cycles does the locking rod lift clear of the Bevel Gear pins to allow it to run back. An extended bell crank system trips the locking rod by means of levers connected in the lower portion of the framework as shown in Fig.4.

Indexing of the Bevel Gear trip rod is by means of a Centre Fork in a Short Coupling fixed to the 3" Axle Rod previously mentioned. The teeth of the Centre Fork are located, one at a time, by a Crank fitted with a Threaded Pin, and this can be seen in Figs.1 & 2.

Further study of Fig.4 shows a peculiar assembly in a Boiler End secured by Rod Sockets to a fore and aft 9½" Angle Girder at the base of the framework. The transverse threaded bores of the Rod Sockets (outer) are used as bolting points for the Boiler End and the inner or centre Rod Socket carries an Electrical Pivot Bolt [Part 545] as the lower bearing for the 3½" Pivot Rod forming the governor shaft.

A governor is necessary to prevent the

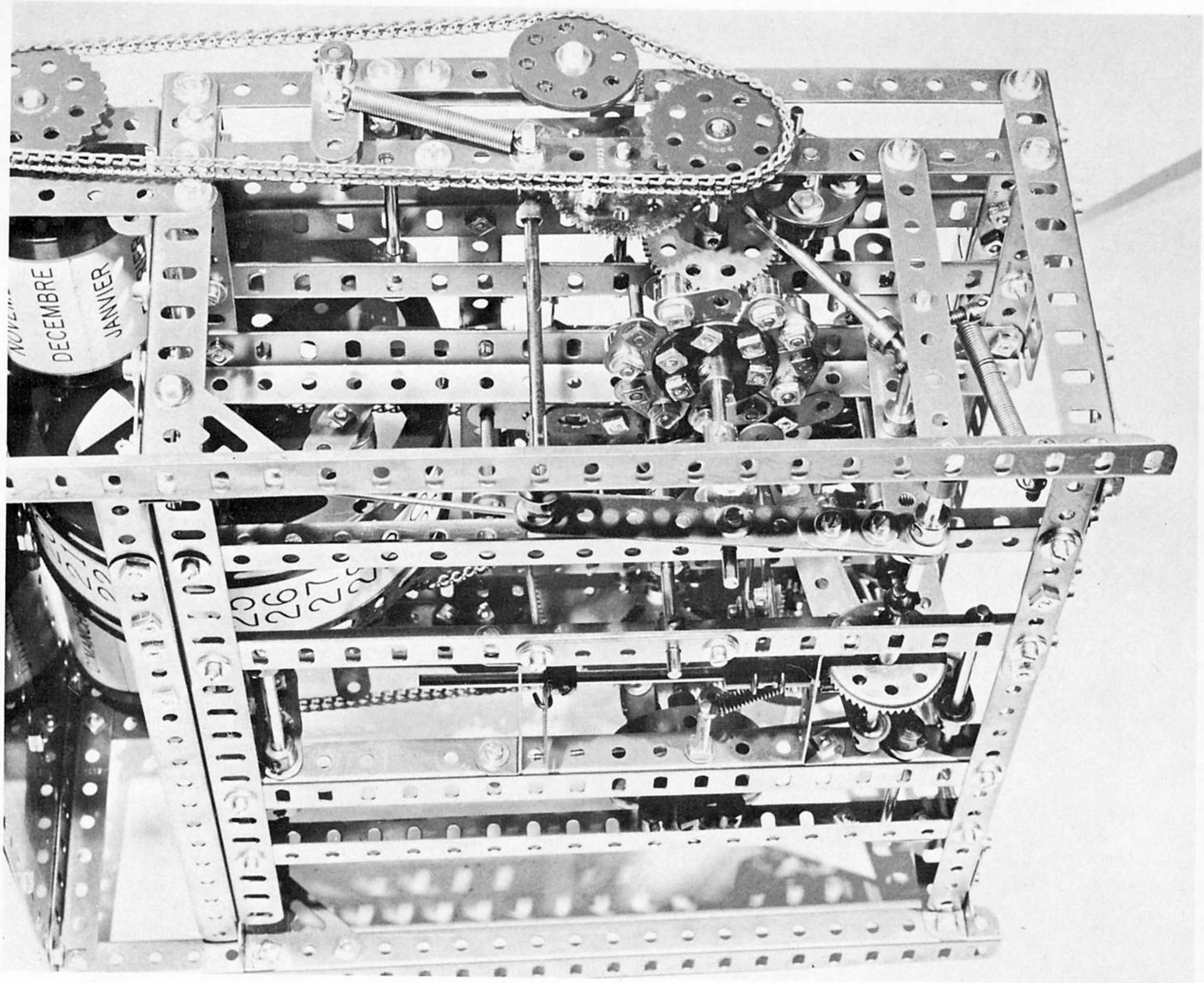

FIG.3 Under view showing the 12-position timing cam for the different lengths of the months. The cam is lifted once every four years to allow 29 days in the February of a leap year

Date Drum 'flying back' out of control. Bob weights for the governor are Collars bolted and lock-nutted to 1½" fibre Insulating Strips [Part 503] which pivot on Threaded Pins in either end of a Double Arm Crank.

These Threaded Pins also secure ½" Angle Brackets holding 1" Wiper Arms [Part 531] stood off by one Washer thickness to act as 'dampers' to the flying bob-weights.

The Double Arm Crank is not bolted to the governor shaft, but it is supported by a Collar from below, and is under pressure from a Compression Spring above it. This prevents any 'overun' of the governor shaft.

The governor is directly driven from the large Bevel Gear by a small Bevel at the upper end of the 3½" Pivot Rod, the upper journal for which is another Electrical Pivot Bolt with pivot hole set into a Fishplate critically positioned under the upper fore and aft 9½" Angle Girder. This can just be seen adjacent to the toothed face of the Large Bevel Gear in Fig.1.

Now we must give our attention to the other side of the mechanism and study the Hub Disc of the Date Drum which can be seen in Fig.2. A series of Bolt shanks, differing in length, can be seen protruding from the Hub Disc close to its rim. The spacing of each bolt shank is arranged exactly at the 'one day' interval ie 1/32 of the full travel of the drum, and at the diameter chosen for the settings; the divisions approximate to ½" spacing. These Bolt shanks of various lengths are set up on a 1½" Flat Girder secured by Fishplates, and require a certain amount of 'juggling' to take up the positions shown in Fig.2.

As the days of the month approach their end, the Bolt shanks come round to the rear position where they strike a horizontal trip lever made from a 5½" Perforated Strip extended by a 3" Narrow Strip overlaid by two holes. This can be clearly seen in Fig.2, and is identified by a Pawl-Without-Boss bolted on at the joint between the two Strips.

The Pawl in fact holds the trip lever in the normal working position by having the tip of its arm bearing against a 1½" Strip stood off from the cross Girder by ¾" Bolts as shown. The forward end of the trip lever rides in the slot of a Strip Coupling and, being a Narrow strip, there is sufficient depth in the Coupling slot for it to fall when triggered in the downward direction by the Bolt shanks on the Day Drum.

A ½" x ½" Double Bracket dropped into the slot of the Coupling acts as a self-locating packing to take up some of the 'slop' in the width of the slot, but still permits a free slide to the Narrow Strip. The lateral position of the trip lever is automatically adjusted by a 12-position cam which locates the position of the Strip Coupling according to the month in register.

It is obvious that the shortest protruding bolt shank on the Hub Disc will meet the trip lever first, and hence will trigger the 'fly-back' of the Day Drum after the shortest run, ie 28 days for the normal February period. The second longest Bolt shank allows the drum to run on for one more day and so only comes into action *once every four years* when February has 29 days in a leap year! The third Bolt shank allows rotation for 30 days, and the longest shank — just hidden from view in Fig.2 — 31 days.

Whatever the month may be (determined by the position of the Strip Coupling), when the appropriate Bolt shank triggers the trip lever, things really begin to happen! The trip lever is actually held against its Pawl stop by Spring Cord tension on a vertical Axle Rod pivotted to the trip lever by the second Collar from the top of the Rod, and this can be seen in Figs.1 & 2.

The bottom end of this Rod is fixed in a Handrail Coupling driving a Contrate Gear on a 4" Axle Rod which also has a release lever fitted to a Crank on the same shaft. This release lever acts in unison when the final 24 hour impulse is given to

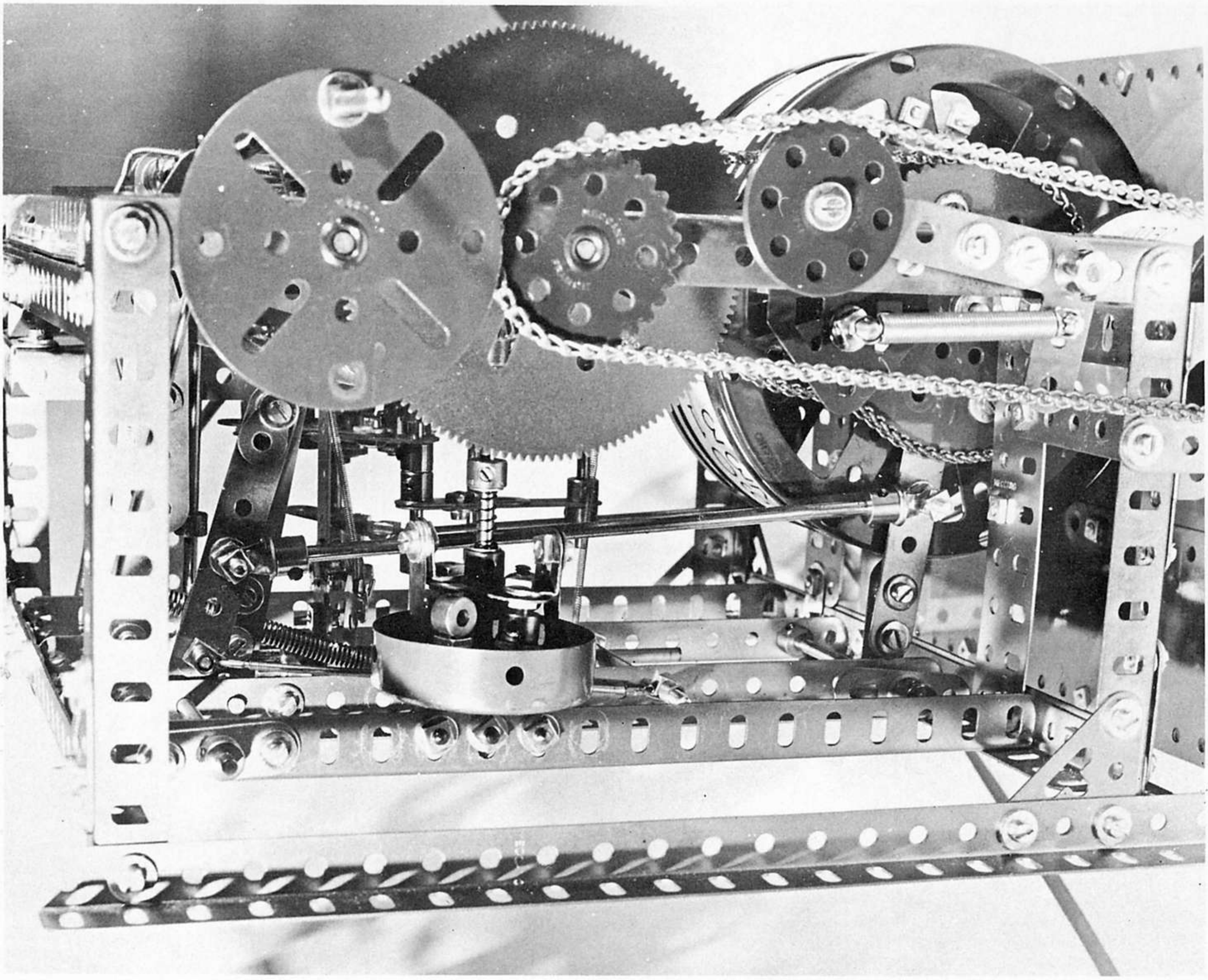

FIG.4 Lower side view showing Boiler End governor casing with bobweights. The levers connected by the lateral Axle Rod assist in tripping the 'fly-back' mechanism when the date drum re-cycles

the input shaft at midnight on the last day of the month.

The motion applied to the large Contrate Wheel drives a 19-tooth Pinion on a horizontal Axle Rod in the bottom of the framework with sufficient movement to work a vertical Perforated Strip attached to the Rod via a Crank; the Strip acting as a slide lever for the overhead layshaft mentioned earlier in the text. The result of throwing this lever is that the layshaft moves to its left, still engaging with the 1" Pinions, but the Pawl with boss on the far end of the layshaft — clearly seen in Fig.2 — trips a second large Flanged Wheel equipped with four Threaded Pins moving it a quarter turn.

The left-hand under-view of Fig.3 shows this Flanged Wheel and a 19-tooth Pinion behind it engaging a 57-tooth Gear Wheel directly on the drive shaft to the Month Drum. As this is by 1:1 ratio Sprocket Wheels, the step-down ratio from the Flanged Wheel is 4:1x3:1=12:1. Thus, at the end of the month the 'end of the day' trigger pulse moves the Date Drum $^1/_{12}$ of a revolution exactly, to display the name of the new month. The Date Drum is re-cycling to Day 1 while this is going on, and part of the energy stored in the Tension Spring is used from the Date Drum 'fly-back' to trigger a lever-and-rod system below, re-setting the horizontal trip lever ready for tripping again at the end of the next month.

The trip lever is drawn to the rear for engagement of its Pawl-Without-Boss by the second Pawl with boss (from the left in Fig.2) on the layshaft which strikes against a Threaded Pin set in a Collar near the top end of the vertical Axle Rod pivotted to the trip lever.

Fig.3 gives an excellent view of the 'heart' of the whole Calendar Unit in the shape of a 12-position cam built up from standard parts. A 6-Hole Bush Wheel has eight 1" Triangular Plates bolted to it so that twelve cam sections can be mounted. Collars are used at each stage where the month position requires 31 days. Threaded Pins are also set into the Triangular Plates where only 30 days occur, and where February comes up, the cam position is left with a vacant hole in the Triangular Plate, and this can clearly be seen in Fig.3.

Bearing against the cam sections is a horizontal 3" Strip fixed by a Crank to a vertical Rod which carries a second Crank about 1½" below. These two Cranks are extended by 2½" Strips to carry another vertical Rod set in two more Cranks free to swing across the unit in a limited arc. It is the top of this Rod that carries the main horizontal trip lever for the month timing. Hence, it is the twelve position cam which sets the critical position of the trip lever and therefore the number of days elapsing before the Date Drum 'flies back'.

The cam is turned via a small Contrate Gear and 50-tooth Pinion (1:1) by the 57-tooth Gear-shaft operating the Sprocket drive to the Month Drum, so the timing cam moves one stage forward at the exact time of the change-over of the month.

Again, indexing for the Month Drum is held by a 2½" Rod, spring-loaded in a Handrail Coupling (see Fig.3), and Bearing against the lower Threaded Pin in the Flanged Wheel.

"A perpetual Calendar?......", well as a final touch by Georges Gombert, a 60-tooth Gear Wheel is driven by a 15-tooth Pinion from the 57-tooth Gear shaft, thus getting a 4:1 reduction from the Month Drive. As the Month Drum takes a whole year to make one revolution, the 60-tooth Gear takes four years! By the simple expedient of a Bolt shank set in a hole in the 60-tooth Gear, the whole Cam shaft if raised by rod and lever at the end of January in a leap year to allow a second cam shaft to ride against the bare shaft, thus giving a 29 day run to February.

Can you beat that?