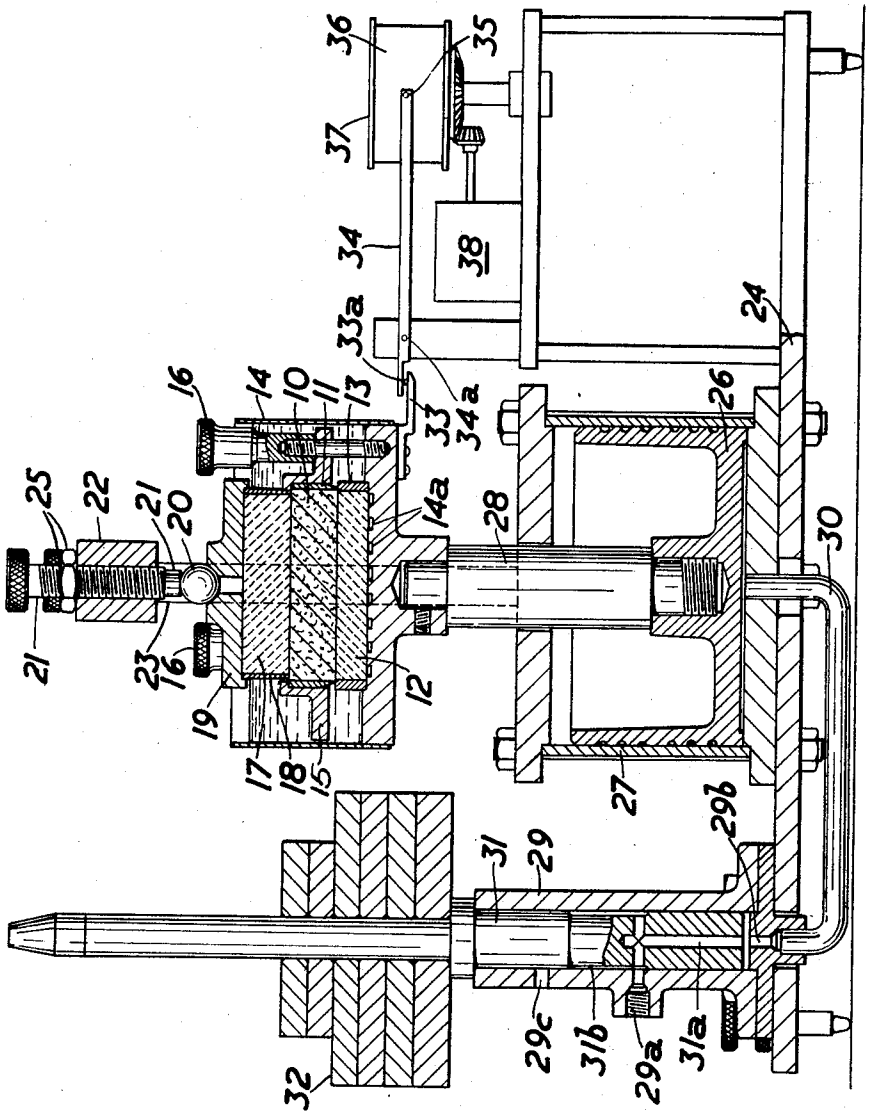
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OEDOMETERS

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OEDOMETERS

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This invention relates to oedometers.

An oedometer, or consolidation apparatus, as it is commonly called, is used for measuring the compression of a sample of soil when the sample is subjected to a constant load.

One disadvantage of existing consolidation apparatus is that it is necessary for a laboratory assistant to take readings at relatively short intervals of time, and eventually to plot all the readings obtained in order to ascertain the rate of compression.

The present invention provides an oedometer comprising means for applying a constant fluid pressure to a soil sample to determine the consolidation of the sample under constant load, and means for automatically recording the consolidation.

The invention also provides an oedometer comprising an abutment member, a movable member, and means for applying a selected constant fluid pressure to said movable member to move it towards said abutment member, whereby a sample interposed between said abutment and said movable member may be subjected to a constant load and the compression of the sample under that load may be measured.

There is further provided by the invention an oedometer comprising a cylinder, a piston movable in said cylinder under fluid pressure, a control valve adapted to control the supply of fluid pressure to said cylinder to maintain a constant loading on said piston, and means for supporting a sample, the arrangement being such that a selected constant load can be applied to the sample by the application of fluid pressure to said piston to to determine the consolidation of the sample under constant load.

One construction of oedometer according to the present invention will now be described, by way of example only, reference being made to the accompanying drawing which shows a sectional side elevation of the oedometer.

In this construction a soil sample **10** is housed in a cylindrical ring **11** and rests on a porous stone **12**, the latter fitting within a lower ring **13** on which the lower edge of the ring **11** rests. The lower ring **13** fits in a depression in the base of a liquid container **14**. The sample is held in position in the container by a locating ring **15** which is secured by three clamping screws **16** (only two of which can be seen in the view illustrated), which latter engage in the base of the container **14**.

A further porous stone **17** fitting within an upper ring **18** rests on the top of the soil sample **10** and is engaged by an abutment plate **19**. The abutment plate **19** is apertured to form a seating for a metal ball **20**, the latter being held on its seating by an adjustable stud **21** which is in threaded engagement with a cross-beam **22**. The cross-beam **22** is supported at each end by vertical support members **23**, only part of one of which is visible in the view illustrated, the members **23** being mounted at their lower ends in the base **24** of the apparatus. Thus, the cross-beam **22** is fixed relative to the base **24**, and

the position of the abutment plate **19** can be adjusted relative thereto by rotation of the stud **21** which, after adjustment, is fixed in position by the lock nuts **25**.

The outer diameter of the upper ring **18** is less than the inner diameter of the cylindrical ring **11**, and it will be clear that the soil sample **10** can be compressed between the stones **12** and **17** by upward pressure applied to the container **14**. Moreover, such compression can be effected in the presence of water which is held in the container **14**, and for this purpose grooves **14***a* are formed in the base of the container **14** to admit water to the underside of the porous stone **12**.

In this construction the upward pressure is provided by fluid pressure which is applied to a piston **26** movable in a cylinder **27** which is fixed relative to the base **24**. The fluid pressure applied to the piston **26** is transmitted to the container **14** by a connecting rod **28**.

The fluid pressure may be derived from a source of any known kind, but with the present apparatus it is convenient to use oil from a reservoir in which the oil is maintained under pressure by compressed air supplied from any suitable source such as a motor driven pump. The oil pressure applied to the cylinder **27** being controlled by means of a valve **29** which is also mounted on the base **24**. A pipe from the oil supply reservoir is connected to the valve inlet **29***a*, and the valve outlet **29***b* is connected by a fluid line **30** to the interior of the cylinder **27**. The valve body is also provided with a relief port **29***c* through which under conditions to be explained oil is returned to the oil supply reservoir. The valve **29** comprises a plunger **31** by which a force due to the fluid pressure applied to the piston **26** is balanced against a weight **32** to maintain the loading upon the sample proportional to the weight **32**. The lower end of the plunger **31** is provided with a passage **31***a*, the horizontal position of which terminates at a mid-portion **31***b* of the plunger which is of reduced diameter to leave a clearance with the inside of the valve body **29**. With the plunger **31** in the position shown the inlet **29***a* communicates with the passage **31***a* and the reservoir is in direct communication with the cylinder **27**. The pressure in the reservoir will normally be such that the force applied to the lower end of the plunger **31** will become greater than the opposing force due to the weight **32**, and consequently the plunger **31** will rise and cut-off the inlet **29***a* from the passage **31***a*. Should the pressure in the cylinder **27** still be such that the upward force is greater the plunger **31** will continue to rise until the mid-portion **31***b* of reduced diameter uncovers the port **29***c*. The resulting reduction in pressure due to escape of oil from the cylinder **27** through the passage **31***a* and port **29***c* will cause the plunger **31** to fall, and it should come to rest in a position at which both ports **29***a* and **29***c* are cut-off. In this way the loading on the sample is maintained substantially constant at a value proportional to the weight **32** irrespective of fluctuations in the pressure in the reservoir. Moreover any desired loading within the range of pressure available from the compressor is readily obtained by suitable alteration of the weight **32**.

For recording the movement of the container **14** it is provided with an arm **33**, a projection **33***a* upon the end of the arm **33** engaging one end of a pivoted lever **34**, the other end of which carries a stylus **35**. The fulcrum **34***a* of the lever **34** is positioned so that the movement of the stylus **35** corresponds to a magnified movement of the container **14**. The stylus **35** has a rounded end of extremely small diameter, e. g. 0.001 of an inch, which engages a surface of a Celluloid strip **36** fixed on a circular drum **37** rotated at a predetermined rate by means of a clock motor **38**. It will be

appreciated that as the sample is compressed and the container **14** moves upwards, the stylus **35** will be displaced laterally relative to the movement of the Celluloid strip **36** and a trace will be formed on the strip **36**.

The stylus **35** acts in known manner to produce a flow of the surface of the Celluloid material resulting in the formation of a trough with corresponding ridges on either side. After completion of a test the strip **36** can be examined by optical projection, preferably with magnification, in order to determine the rate and extent of compression of the sample. Preferably, the stylus **35** is mounted so that its pressure on the strip **36** can be adjusted.

It will be clear that an oedometer of the form described can be set up and then be left with the minimum of attention until the automatic recording is completed at the end of the test period, which period may extend with periodically increased load for as much as six days. The necessity for an assistant to take readings continuously is thereby avoided with consequent saving in labour, and furthermore the record is obtained in readily readable manner without the necessity for plotting curves from the readings as with existing apparatus. A further disadvantage of existing apparatus is that the lever system used therein for loading the sample has required a heavy, and therefore cumbersome, framework and has also suffered from the drawback that false readings may result from vibration transmitted to the machine. The elimination of the lever system and consequently the heavy framework enables the present apparatus to be of much more compact form.

It will be understood that where two or more oedometers are used only a single fluid reservoir need be provided, although separate control valves are required for each apparatus.

Although the use of oil has been referred to, other fluid media may be used. Thus, compressed air may be used in conjunction with a pressure control valve of known form.

What I claim is:

1. In an oedometer, an abutment, a first porous stone engaging said abutment, an open-ended soil sample housing having a uniform internal cross-section, a second porous stone, each of said porous stones being positioned adjacent one end of said housing respectively, said first stone having a cross-section similar to the internal cross-section of said housing and being slightly smaller than said internal cross-section whereby said first stone can enter said housing to compress against the second stone a soil sample contained in said housing and restrained from lateral movement by said housing, a cylinder, said cylinder having a port through which fluid under pressure is admitted, a piston movable in said cylinder under fluid pressure, a connecting rod secured to said piston, a liquid containing vessel mounted on said connecting rod, said liquid containing vessel having a base on which said second stone rests with said first stone and said housing located within said vessel whereby consolidation can be effected in the presence of liquid, a fluid-pressure regulating valve for maintaining fluid under substantially constant pressure, and a fluid carrying connection between said valve and said cylinder port.

2. In an oedometer, a fixed abutment, a first porous stone engaging said abutment, an open-ended soil sample housing, a second porous stone, each of said porous stones being positioned adjacent one end of said housing respectively, said first stone being smaller than the opening in the end of the housing adjacent which it is mounted whereby said first stone can enter said housing to compress against the second stone a soil sample contained in said housing and restrained from lateral movement by said housing, a cylinder, said cylinder having a port through which fluid under pressure is admitted, a piston movable in said cylinder under fluid pressure, a connecting rod secured to said piston, a liquid containing vessel mounted on said connecting rod, said liquid containing vessel having a base on which said second stone rests with said first stone and said housing located within said vessel whereby consolidation can be effected in the presence of liquid, a fluid-pressure regulating valve for maintaining fluid under substantially constant pressure, and a fluid carrying connection between said valve and said cylinder port.

3. In an oedometer, an abutment, an abutment engaging member, a first porous stone, said first porous stone bearing against said abutment engaging member, an open-ended soil sample housing having a uniform internal cross-section, a second porous stone, each of said porous stones being positioned adjacent one end of said housing respectively, said first stone having a cross-section similar to the internal cross-section of said housing and being slightly smaller than said internal cross-section whereby said first stone can enter said housing to compress against the second stone a soil sample contained in said housing and restrained from lateral movement by said housing, a cylinder, said cylinder having a port through which fluid under pressure is admitted, the position of said abutment relative to said cylinder being adjustable, a piston movable in said cylinder under fluid pressure, a connecting rod secured to said piston, a liquid containing vessel mounted on said connecting rod, said liquid containing vessel having a base on which said second stone rests with said first stone and said housing located within said vessel whereby consolidation can be effected in the presence of liquid, a fluid-pressure regulating valve for maintaining fluid under substantially constant pressure, and a fluid carrying connection between said valve and said cylinder port.

4. An oedometer according to claim 3, comprising a beam fixed relative to said cylinder, said abutment comprising a stud in screw-threaded engagement with said beam.

References Cited in the file of this patent

UNITED STATES PATENTS

1,931,925	Hopkins	Oct. 24, 1933
1,985,598	Carver	Dec. 25, 1934
2,130,751	Van Der Meer	Sept. 20, 1938
2,191,282	Lewis	Feb. 20, 1940
2,259,491	Roller	Oct. 21, 1941
2,273,152	Sontag	Feb. 17, 1942
2,656,718	Dames et al.	Oct. 27, 1953

FOREIGN PATENTS

425,725	Italy	Oct. 10, 1947