SYNOPSIS

The thesis consists of seven chapters.

Chapter I is introductory and describes the physical importance of cylindrical symmetric Einstein-Rosen metric, the 'stiff fluid' distributions, scalar meson fields and W-M-P (Weyl-Majumdar-Papapetrou) class of solutions. A critical review of the problems considered by various authors relevant to our investigations carried out in subsequent chapters is also given. This has helped in bringing forth in proper perspective the motivation of our investigations and the results obtained.

In Chapter II, we have considered the problem of charged perfect fluid distributions when the space-time is described by Einstein-Rosen metric. It is shown that the following general results hold good:

(i) the cosmological constant $\Lambda = 0$,

(ii) the charge density $\sigma = 0$

and

(iii) the perfect fluid reduces to 'stiff fluid' which is characterised by equivalence of pressure and mass density.(Some authors use the name of 'Zel'dovich fluid' for 'stiff fluid'.)

With the above inherent restrictions the problem is solved and sets of particular exact solutions are obtained. The

solutions of Brans-Dicke theory for the problem of source free electromagnetic fields have also been derived from these solutions.

Chapter III deals with the construction of the W-M-P class of solutions corresponding to different cases considered in Chapter II. We have developed techniques for establishing W-M-P relations from particular cases having one electromagnetic potential to the general case consisting of both the electromagnetic potentials which is possible after establishing a linear relation among the electromagnetic potentials. We have also established theorems to generate solutions for 'stiff fluid' coupled with source free electromagnetic field from the corresponding 'stiff fluid' solutions.

In Chapter IV, we have studied the physical interpretation of the solutions obtained in Chapter II with particular reference to their singular behaviour. Some solutions represent a hollow tube around the axis of symmetry whereas some have singularities on the axis but not due to the 'stiff fluid'. We have also shown that the electromagnetic field is null in one case and is non-null in other cases and is non-uniform in all cases (i.e., $F_{ij;k} \neq 0$ where F_{ij} is the Maxwell field tensor).

In Chapter V , we have considered the most general problem of charged perfect fluid in presence of massive scalar field. Due to the symmetry imposed by the Einstein-Rosen

metric as in the problem discussed in Chapter II, the validity of the problem demands that :

(i) the cosmological constant $\Lambda = 0$,

(ii) the charge density $\sigma = 0$,

(iii) the mass parameter of the scalar field $M = 0$ (i.e., zero-mass scalar field)

and

(iv) the perfect fluid reduces to the 'stiff fluid'.

Sets of exact solutions of the problem have been obtained.

Chapter VI deals with the W-M-P class of solutions for the coupled source free electromagnetic and zero-mass scalar field in presence of 'stiff fluid' distributions. With the help of W-M-P relation solution generation theorems have been established to construct solutions for coupled source free electromagnetic and zero-mass scalar field in presence of 'stiff fluid' from those of the couple field due to 'stiff fluid' and zero-mass scalar fidld. We have developed the techniques for particular cases as well as general case where both the electromagnetic potentials are taken into account.

In Chapter VII, we have investigated the physics involved in the solutions obtained in Chapter V. The contribution of zero-mass scalar field is in particular studied in addition to those physical fields investigated in Chapter IV.